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# REPORT FOR THE CONFERENCE ON POLLUTION OF RARITAN BAY AND ADJACENT INTERSTATE WATERS. THIRD SESSION, VOLUME II. SOURCES OF POLLUTION

Federal Water Pollution Control Administration
Metuchen, New Jersey

May 1967

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# REPORT

for

# THE CONFERENCE ON POLLUTION OF RARITAN BAY AND ADJACENT INTERSTATE WATERS

## THIRD SESSION

## VOLUME II-SOURCES OF POLLUTION

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHEAST REGION - RARITAN BAY PROJECT
METUCHEN, N.J.
MAY 1967

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# SOURCES OF POLLUTION

## General

Major pollutional loads to the study waters are presented ~~in Table I.~~ Examination of these data indicates the large demand placed upon the assimilative capacity of these waters by the discharge of treated and untreated municipal and industrial wastes. Raritan Bay and Arthur Kill receive directly more than 480 MGD of wastes from a tributary population exceeding 1.3 million people. These discharges represent a BOD loading of 430,000 lbs/day.

The discharge of additional wastes in adjacent waters increases the magnitude and impact of the direct loads. When discharges to Upper Bay and Raritan River are included the total wastes volume approaches 1,500 MGD, which represents a BOD loading of greater than 1,300,000 lbs/day from a population exceeding 5.0 million people.

Contamination by pollutants other than BOD from these same sources is also a significant problem. Bacteriological pollution results from the discharge of more than 900 MGD of unchlorinated and raw municipal wastes emanating from a tributary population of 3.8 million persons. Such pollution constitutes a definite hazard to the health of persons having contact with these waters.

Nearly 75% of the total wastes volume is from industry. This results in pollution of study waters by a variety of contaminants in addition to oxygen consuming material. Pollutants such as oil, phenol, phosphate and nitrogen result in unsightly conditions, destruction of desirable aquatic life, tainting of fish and shellfish and eutrophication of the water.

Additional pollution results from the discharge of more than 1.0 billion gallons per day of "hot" cooling water from power generating plants adjacent to these waters. Further contamination occurs in localized areas due to the discharge of wastes from recreational and commercial vessels. The overflow of sewage from combined storm-sanitary sewer systems also represents an important factor in pollution of these waters.

## TABLE I

## MUNICIPAL AND INDUSTRIAL WASTE LOADINGS[1]

| Type Source | Flow MGD | Loadings (lbs/day) BOD | Loadings (lbs/day) Suspended Solids | Tributary Population | Population Equivalent (BOD) Discharged |
|---|---|---|---|---|---|
| **DISCHARGES TO RARITAN BAY** | | | | | |
| Municipal | 72.1 | 182,500 | 40,560 | 507,800 | 1,069,200 |
| Industrial | 0.1 [2] | 2,500 | | | 14,700 |
| Total | 72.2 [2] | 185,000 | | | 1,083,900 |
| **DISCHARGES TO ARTHUR KILL** | | | | | |
| Municipal | 81.8 | 138,360 | 55,350 | 831,000 | 812,750 |
| Industrial | 367.3 [2] | 104,640 | | | 615,000 |
| Total | 449.1 [2] | 243,000 | | | 1,427,750 |
| **DISCHARGES TO RARITAN RIVER** | | | | | |
| Municipal | 2.0 | 1,605 | 845 | 20,365 | 9,430 |
| Industrial | 85.7 [2] | 70,100 | | | 421,000 |
| Total | 87.7 [2] | 71,707 | | | 430,430 |
| **TOTAL DISCHARGES TO STUDY AREA** | | | | | |
| Municipal | 155.9 | 322,465 | 96,755 | 1,359,165 | 1,891,380 |
| Industrial | 453.1 | 177,240 | | | 1,050,700 |
| Total | 609.0 | 499,705 | | | 2,942,080 |
| **DISCHARGES TO UPPER BAY** | | | | | |
| Municipal | 915.9 | 808,510 | 645,100 | 3,815,100 | 4,758,400 |
| Industrial | N.D. [3] | N.D. | N.D. | N.D. | N.D. |
| Total | 915.9 | 808,510 | 645,100 | 3,815,100 | 4,758,400 |

NOTES:
1. Does not include additional wastes loadings from recreational and commercial vessels, or from stormwater overflow.
2. Excludes flow from power generating industry.
3. No data available.

## MUNICIPAL AND INSTITUTIONAL WASTES

### General

Treated and raw municipal and institutional wastes discharged to Raritan Bay, Arthur Kill, Raritan River, and that portion of Upper Bay to close proximity to the Narrows, are summarized in Table II.

Raritan Bay receives the direct discharge of treated and untreated wastes from more than 511,000 persons. A total of 20 wastewater treatment plants, serving 508,000 people, discharge 182,000 lbs/day of BOD and 40,000 lbs/day of suspended solids. On a population basis, more than 99% of the domestic wastes discharged receives treatment of some form. The only major source of raw municipal wastes is the Tottenville area of Staten Island, N.Y., with an estimated population of 3,000 people.

Treated municipal wastes from nearly 830,000 persons, representing a BOD load of 137,000 lbs/day and 54,000 lbs/day of suspended solids are discharged directly to the Arthur Kill. There is no significant discharge of untreated municipal or institutional wastes to the Kill, although some raw discharges do exist, notably in the City of Elizabeth, N.J.

That portion of the Raritan River within the Project study area receives treated wastes from 20,400 people. The seven wastewater treatment plants discharging to the waterway and its tributaries contribute a load of 1,600 lbs/day of BOD and 800 lbs/day of suspended solids.

Wastes discharged to Upper Bay have been included in Table II since the transfer of pollutants through the Narrows has a significant effect on the easterly portion of Raritan Bay. Upper Bay receives wastes from more than 3.8 million people, of which, that from 1.6 million is discharged without treatment. Five wastewater treatment plants account for 343 of the 915 MGD discharged. Raw wastes amounting to 572 MGD are discharged from Manhattan, Red Hook Section of Brooklyn and easerly Staten Island. The total load is estimated at 808,000 lbs/day of BOD and 645,000 lbs/day of suspended solids. It is important to note that all of the municipal plants do not practice chlorination.

### Sources

Known sources of municipal and institutional wastes discharged to study area waters are presented in Table III. These data are based on Project sampling programs or information provided by the Interstate Sanitation Commission and the New Jersey State Department of Health.

# TABLE II

## SUMMARY OF MUNICIPAL & INSTITUTIONAL WASTES

| Receiving Water and Origin | | Treated Waste | | | | | | Untreated Waste | | | | | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Plants | Population Served | Flow | Loadings lbs/day | | Pop. Equiv. | Population | Flow | Loadings lbs/day | | Pop. Equiv. | Population | Flow | Loadings lbs/day | | Pop. Equiv. |
| | | | | MGD | BOD | Susp. Solids | (BOD) | | MGD | BOD | Susp. Solids | (BOD) | | MGD | BOD | Susp. Solids | (BOD) |
| Raritan Bay | N.J. | 13 | 415,175 | 60.6 | 178,430 | 36,760 | 1,045,250 | 0 | 0 | 0 | 0 | 0 | 415,175 | 60.6 | 178,430 | 36,760 | 1,045,250 |
| | N.Y. | 7 | 89625 | 11.2 | 3,560 | 3,140 | 20950 | 3,000 | 0.3 | 510 | 660 | 3,000 | 92,625 | 11.5 | 4,070 | 3,800 | 23,950 |
| TOTAL | | 20 | 504,800 | 71.8 | 181,990 | 39,900 | 1,066,200 | 3,000 | 0.3 | 510 | 660 | 3,000 | 507,800 | 72.1 | 182,500 | 40,560 | 1,069,200 |
| | | | | | | | | | | | | | | | | | |
| Arthur Kill | N.J. | 6 | 820,000 | 80.6 | 135,340 | 53,990 | 795,000 | 5,000 | 0.5 | 1,160 | 760 | 6,850 | 825,000 | 81.1 | 136,500 | 54,750 | 801,850 |
| | N.Y. | 1 | 6,000 | 0.7 | 1,860 | 600 | 10,900 | 0 | 0 | 0 | 0 | 0 | 6,000 | 0.7 | 1,860 | 600 | 10,900 |
| TOTAL | | 7 | 826,000 | 81.3 | 137,200 | 54,590 | 805,900 | 5,000 | 0.5 | 1,160 | 760 | 6,850 | 831,000 | 81.8 | 138,360 | 55,350 | 812,750 |
| | | | | | | | | | | | | | | | | | |
| Raritan River | All N.J. | 7 | 20,365 | 2.0 | 1,605 | 845 | 9,430 | 0 | 0 | 0 | 0 | 0 | 20,365 | 2.0 | 1,605 | 845 | 9,430 |
| | | | | | | | | | | | | | | | | | |
| Upper Harbor | N.J. | 3 | 1,405,100 | 238.4 | 436,970 | 255,820 | 2,572,200 | 0 | 0 | 0 | 0 | 0 | 1,405,100 | 238.4 | 436,970 | 255,820 | 2,572,200 |
| | N.Y. | 2 | 810,000 | 104.5 | 99,640 | 37,250 | 586,200 | 1,600,000 | 573.0 | 272,000 | 352,000 | 1,600,000 | 2,410,000 | 674.5 | 371,540 | 389,250 | 2,186,200 |
| TOTAL | | 5 | 2,215,100 | 342.9 | 536,610 | 293,100 | 3,158,400 | 1,600,000 | 573.0 | 272,000 | 352,000 | 1,600,000 | 3,815,100 | 915.9 | 808,510 | 645,100 | 4,758,400 |
| | | | | | | | | | | | | | | | | | |

TABLE III

MUNICIPAL AND INSTITUTIONAL WASTES SOURCES 1/

| Source | State | Treatment | Year Built/ Altered | Population Served | Flow, MGD |  | Loadings, lbs/day |  | Pop. Equiv. (BOD) 2/ |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | De-sign | Ave Daily | BOD | Suspended Solids |  |
| RARITAN BAY |  |  |  |  |  |  |  |  |  |
| Highlands | N.J. | Primary | 1929 | 4,200 | 1.7 | 0.8 | 660 | 550 | 3,880 |
| Atlantic Highlands | N.J. | Primary | 1929 | 4,200 | 0.6 | 0.6 | 650 | 410 | 3,820 |
| Leonardo Naval Depot | N.J. | Intermediate | 1949 | 75 | - | 0.02 | Small | Small | Small |
| Keansburg | N.J. | Primary | 1950/1963 | 7,500 | 3.2 | 2.9 | 990 | 1,160 | 5,820 |
| Keyport | N.J. | Primary | 1929/1962 | 7,000 | 1.0 | 1.0 | 670 | 440 | 3,940 |
| Matawan Boro3/ | N.J. | Primary | 1923/1962 | 3,600 | 0.8 | 0.4 | 430 | 320 | 2,520 |
| Matawan Twp. | N.J. | Secondary | 1953 | 1,000 | - | 0.08 | Small | Small | Small |
| Madison Twp. | N.J. | Primary | 1963 | 3,500 | 1.2 | 0.5 | 430 | 220 | 2,520 |
| Sayreville - Morgan 3/ | N.J. | Primary | 1952 | 2,000 | 0.3 | 0.2 | 240 | 180 | 1,400 |
| South Amboy | N.J. | Primary | 1939 | 8,400 | 1.0 | 0.9 | 790 | 340 | 4,650 |
| Middlesex County 4/ | N.J. | Primary | 1959/1965 | 330,900 | 52.0 | 46.8 | 165,450 | 30,200 | 974,000 |
| Perth Amboy | N.J. | Primary | 1934 | 38,000 | 10.0 | 6.2 | 8,120 | 2,940 | 42,700 |
| Junior High School #7 5/ | N.Y. | Secondary | 1965 | 2,100 | 0.02 | - | INSIGNIFICANT | INSIGNIFICANT | INSIGNIFICANT |
| Mt. Loretto Home #1 5/ | N.Y. | Septic Tank $+Cl_2$ | 1963 | 415 | - | 0.04 |  |  |  |
| Mt. Loretto Home #2 5/ | N.Y. | Septic Tank $+Cl_2$ | 1963 | 760 | - | 0.08 |  |  |  |
| Richmond Mem. Hospital 5/ | N.Y. | Septic Tank $+Cl_2$ | 1936/1954 | 360 | - | 0.04 |  |  |  |
| Daytop Lodge | N.Y. | Septic Tank | - | 80 | - | - |  |  |  |
| Matawan Twsp #3 | N.J. | Secondary | 1966 | 4,800 | 0.7 | 0.2 | - | - | - |

TABLE III (Cont'd)

MUNICIPAL AND INSTITUTIONAL WASTE SOURCES 1/

| Source | State | Treatment | Year Built/ Altered | Population Served | Flow, MGD | | Loadings, lbs/day | | Pop. Equiv. (BOD) 2/ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | De-sign | Ave Daily | BOD | Suspended Solids | |
| RARITAN BAY (Cont'd) | | | | | | | | | |
| St. Joseph's School 5/ | N.Y. | Intermediate | 1964 | 910 | 0.02 | - | Small | Small | Small |
| Oakwood Beach | N.Y. | Secondary | 1956 | 85,000 | 15.0 | 11.0 | 3,560 | 3,140 | 20,950 |
| Tottenville3/ 5/ | N.Y. | None | - | 3,000 | - | 0.3 | 510 | 660 | 3,000 |
| ARTHUR KILL | | | | | | | | | |
| Woodbridge-Sewaren | N.J. | Primary | 1954 | 30,000 | 10.0 | 3.9 | 4,350 | 2,700 | 25,600 |
| Carteret | N.J. | Primary | 1953 | 15,000 | 3.0 | 2.5 | 2,790 | 1,670 | 16,400 |
| Rahway Valley | N.J. | Primary | 1927 | 180,000 | 16.7 | 19.7 | 30,200 | 12,950 | 177,500 |
| Linden-Roselle | N.J. | Primary | 1952 | 120,000 | 12.5 | 7.9 | 22,000 | 7,170 | 129,500 |
| Joint Meeting6/ | N.J. | Primary | 1937 | 475,000 | 100.0 | 46.6 | 76,000 | 29,500 | 446,000 |
| Elizabeth 7/ | N.J. | None | - | Unknown | - | 0.5 | 1,160 | 760 | 6,850 |
| Willowbrook State School8/ | N.Y. | Primary | 1941 | 6,000 | 0.6 | 0.7 | 1,860 | 600 | 10,900 |
| RARITAN RIVER | | | | | | | | | |
| Helmetta 9/ | N.J. | Secondary | - | 665 | - | 0.03 | Small | Small | Small |
| Jamesburg 9/ | N.J. | Secondary | - | 1,500 | - | 0.35 | 210 | 60 | 1,230 |
| Manville 9/ | N.J. | Primary | - | 8,600 | - | 1.0 | 620 | 250 | 3,650 |
| Woodbridge-Keasby 9/ | N.J. | Primary | - | 8,000 | - | 0.5 | 655 | 445 | 3,850 |

## TABLE III (Cont'd)

## MUNICIPAL AND INSTITUTIONAL WASTES SOURCES 1/

| Source | State | Treatment | Year Built/ Altered | Population Served | Flow, MGD | | Loadings, lbs/day | | Pop. Equiv. (BOD) 2/ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | De-sign | Ave Daily | BOD | Suspended Solids | |
| RARITAN RIVER (Cont'd) | | | | | | | | | |
| E. Brunswick Turnpike 9/ | N.J. | Secondary | - | 500 | - | 0.01 | Small | Small | Small |
| Sayreville-Melrose 10/ | N.J. | Primary | 1949 | 1,000 | 0.1 | 0.03 | 120 | 90 | 700 |
| Raritan Depot | N.J. | Secondary | 1917 | 100 | - | 0.06 | Small | Small | Small |
| UPPER NEW YORK HARBOR | | | | | | | | | |
| Bayonne 8/ | N.J. | Primary | 1954 | 75,000 | 20.0 | 6.7 | 9,230 | 4,600 | 54,200 |
| Jersey City East 8/ | N.J. | Primary | 1957 | 180,100 | 46.6 | 31.7 | 40,540 | 20,820 | 238,000 |
| Passaic Valley 8/ 11/ | N.J. | Primary | 1937 | 1,150,000 | - | 200.0 | 387,200 | 230,400 | 2,280,000 |
| Owl's Head 8/ | N.Y. | Intermediate | 1952 | 750,000 | 160.0 | 97.8 | 90,660 | 33,250 | 534,000 |
| Port Richmond 8/ | N.Y. | Primary | 1953 | 60,000 | 10.0 | 6.7 | 8,880 | 4,030 | 52,200 |
| Manhattan 3/ 5/ 12/ | N.Y. | None | - | 1,000,000 | - | 500.0 | 170,000 | 220,000 | 1,000,000 |
| Brooklyn -Red Hook 3/ 5/ | N.Y. | None | - | 500,000 | - | 60.0 | 85,000 | 110,000 | 500,000 |
| Staten Island East 3/ 5/ 13/ | N.Y. | None | - | 100,000 | - | 13.0 | 17,000 | 22,000 | 100,000 |

NOTES:

1. Unless otherwise noted, data are based on results of Project studies.

2. Calculated from BOD loading, using 1 PE = 0.17 lbs/day BOD.

3. Loads calculated on basis of 0.17 lbs per capita per day BOD and 0.22 lbs per capita per day suspended solids in raw sewage, with following treatment removed efficiencies:

   Primary: BOD 30%; Suspended solids 60%
   Secondary: BOD 85%; Suspended solids 95%

4. Population served from ISC; Loadings and flow based on Project studies.

5. Population and flows estimated.

6. Population is 1950 tributary population.

7. Population served unknown. Flow data from ISC indicates 300,000 gpd from Bayway area; 200,000 gpd from Singer area. Loadings calculated using data for Elizabeth Joint Meeting, removals as given in Note 3, and prorating on basis of ratio of flows.

8. Data from ISC.

9. Data from New Jersey State Department of Health.

10. Flow and population from ISC. Loads calculated per Note 3.

11. In 1965, outfall line was broken. Plant now discharges to Newark Bay.

12. Population increases to estimated 3.5 million during working day.

13. Includes St. George, Stapleton and West Brighton, Staten Island, N.Y.

# TABLE IV

## SUMMARY OF OPERATIONS AND MAINTENANCE OF MAJOR MUNICIPAL TREATMENT PLANTS

| PLANT | CHLORINE REQD.[4] | REQ. % REM. SUS. SOLIDS[4] | 24-HOUR STUDIES | | | GRAB SAMPLE COLIFORM | | SATISFACTORY | OPERATION[5] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NO. | NO. MTG. BACT. | NO. MTG. S.S. | NO. | NO. > 1.0/ML | PERSONNEL | LAB CONTROL | RECORDS |
| OAKWOOD BEACH | YES | 60 | 4 | 4 | 3[1] | 68 | 22 | YES | YES | YES |
| JOINT MEETING | NO | 10 | 1 | - | 1 | 11 | - | YES | YES | YES |
| LINDEN-ROSELLE | NO | 10 | 1 | - | 1 | 11 | - | YES | YES | YES |
| RAHWAY VALLEY | NO | 10 | 1 | - | 1 | 11 | - | YES | YES | YES |
| CARTERET | YES | 10 | 1 | 0 | 1 | 11 | 5 | YES | NO | YES |
| SEWAREN | YES | 10 | 1 | 1 | 1 | 11 | 6 | YES | NO | YES |
| PERTH AMBOY | YES | 60 | 5 | 4 | 2[1] | 65 | 35 | NO | NO | NO |
| KEASBY | YES | 60 | 1 | 1 | 0 | 19 | 2 | YES | YES | YES |
| RARITAN DEPOT | YES | 60 | - | - | - | 18 | 1 | YES | NO | YES |
| MIDDLESEX COUNTY | YES | 60 | 4 | 3 | 4 | 68 | 23 | YES | YES | YES |
| SAYREVILLE-MELROSE | YES | 60 | - | - | - | 20[2] | 1 | - | - | - |
| SOUTH AMBOY | YES | 60 | 4 | 4 | 3[1] | 66 | 8 | YES | NO | YES |
| SAYREVILLE-MORGAN | YES | 60 | 1[3] | 1 | 1 | 19 | 3 | YES | NO | YES |
| MADISON TOWNSHIP (KNOLLCROFT) | YES | 60 | 3 | 3 | 2 | 22 | 2 | YES | NO | YES |
| MATAWAN BORO. | YES | 60 | 1 | 1 | 0 | 22 | 4 | YES | NO | YES |
| MATAWAN TOWNSHIP | YES | 60 | - | - | - | 18 | 3 | YES | NO | YES |
| MATAWAN TOWNSHIP #3 | YES | 60 | - | - | - | 1 | 0 | YES | YES | YES |
| KEYPORT | YES | 60 | 4 | 4 | 2 | 63 | 13 | NO | NO | YES |
| KEANSBURG | YES | 60 | 3 | 2 | 0 | 59 | 30 | YES | NO | YES |
| LEONARDO | YES | 60 | 1[3] | 1 | 1 | 19 | 2 | YES | NO | YES |
| ATLANTIC HIGHLANDS | YES | 60 | 4 | 1 | 1 | 69 | 4 | NO | NO | NO |
| HIGHLANDS | YES | 60 | 4 | 3 | 1 | 69 | 16 | YES | NO | NO |

KEY

1- ONLY 3 STUDIES WITH SOLIDS DATA
2- ISC DATA
3- 8-HOUR STUDY
4- REQUIREMENTS FOR EFFLUENT QUALITY ESTABLISHED BY ISC CLASSIFICATION OF RECEIVING WATER
5- SATISFACTORY AS COMPARED WITH "RECOMMENDATIONS FOR MINIMUM PERSONNEL AND LABORATORY CONTROL" CONFERENCE OF STATE SANITARY ENGINEERS

# HIGHLANDS

## Background

The Highlands, N.J. plant, owned and operated by the Borough was constructed in 1928-29 to serve a population of approximately 15,000 people. Presently, the plant serves an average population of 4,200 with a summer peak of 11,000 persons. The design flow is reported to be 1.7 MGD.

The existing plant, which has never undergone expansion of any type, provides primary treatment for domestic and commercial wastes developed within the community.

The separate sewer system, constructed more than three and one half decades ago, is provided with two pumping stations - Waterwich Avenue and South Bay Avenue. Reportedly, these stations cannot be bypassed. The quantity of flow handled by these two facilities, in relation to the total sewage flow, is not known since accurate flow records are not available at the treatment plant nor at the lift stations. The area served by the sewer system includes the Borough of Highlands and the Monmouth Hills Development.

## Treatment

The plant consists of a bar screen, four single story settling (septic) tanks, chlorine contact chamber and glass covered sludge drying beds. The plant's 16-inch diameter outfall line was designed to traverse the Shrewsbury River and Sandy Hook and discharge into the Atlantic Ocean. This line was broken in the early 1950's, and effluent presently discharges into the Shrewsbury approximately 300 feet south of Buoy 13. This break was verified with dye by Project personnel on October 11, 1962. There is no known bypass at the treatment plant. However, during severe rain storms the settling tanks flood, with the overflow discharging into Sandy Hook Bay via street gutters.

## Findings

According to ISC records, there has been no method of accurately determining flow at this installation for at least the past eight years. To measure the flow, the Raritan Bay Project on July 28-29, 1964, conducted a 24-hour comprehensive flow study. Results of this investigation indicated that the plant's average flow approximates 0.85 MGD, and the maximum 1.4 MGD. This hydraulic study indicated that infiltration is a major problem. It is estimated that the background level for seepage is 0.4 MGD.

Presently, under normal conditions, two of the single story settling tanks are operated in parallel, while the remaining two units are cleaned and drained. Operation of the tanks are alternated approximately every six months. Based on an average flow of 0.85 MGD the detention time is 3.9 hours, which is below that required as a minimum by the New Jersey State Health Department design regulations. According to these rules the capacity of single story settling tanks, without sludge digestion, "shall be at least eight hours based on design flow." If detention time is calculated on the actual 1.7 MGD design flow, the holding capacity of the tanks would be approximately two hours.

## Performance Summary

| Date | Flow* mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **24 hour studies** | | | | | | |
| 8-9,10-62 | 0.85 | 141 | 42 | 142 | - | 70 |
| 10-4,5-62 | 0.85 | 84 | 35 | 70 | 42 | 33 |
| 12-6,7-62 | 0.85 | 48 | 38 | 62 | 76 | 25 |
| 8-22,23-63 | 0.85 | 46 | 64 | 103 | 3 | 37 |
| **Grab samples** | | | | | | |
| 8-7-62 to 9-11-63 (50 samples) | 0.85 | 59 | - | 112 | - | 24 |
| 10-6-64 to 12-21-65 (14 samples) | 0.85 | 61 | | 75 | - | 21 |
| 1-18-66 to 5-18-66 (5 samples) | 0.85 | 72 | | 72 | - | 20 |

*Based on hydraulic study 7-28,29-64

During three of the four 24-hour studies conducted, the effluent failed to meet ISC requirements for solids removal. Bacteriologically, the plant failed to meet the coliform requirements during one of the day-long studies. From data obtained, it is evident that chlorination is relied upon heavily to provide a reasonable degree of treatment. Control of the application of chlorine at this point is poor, as there is no continual residual chlorine indicator tied into the feed rate. As a result, the dosage applied in many instances is inadequate during high flow periods. For example: During the 24-hour study of October 4-5, 1962, the coliform counts during the morning high flow periods ranged from 170 to 16,000 organisms per 100 ml.

Laboratory control procedures at Highlands do not meet the minimum requirements of the Conference of State Sanitary Engineers, which recommend daily tests for settleable solids and chlorine residual; and occasionally pH of the raw wastes. The only tests performed at Highlands are air and effluent temperatures and chlorine residual every two hours. No tabular record, as recommended, is kept of test results; although an operating diary-type log is maintained.

## ATLANTIC HIGHLANDS

### Background

Atlantic Highlands, N.J., located on the southern shore of Sandy Hook Bay approximately two miles west of the Atlantic Ocean, is served by a 0.6 MGD primary treatment plant. The installation, constructed in 1929, has never been expanded or modernized.

Based on information supplied by the Borough, the present population of 4,200 people increases by approximately 100 during the summer months. The popularity of this area as a summer resort, however, suggests a weekend population considerably in excess of 4,300 persons. Based on available data, the plant is presently handling an average daily flow of 590,000 gallons, even though records indicate flows as high as 1.09 MGD. The reason for this discrepancy is that the propellar-type flow meter, located after the high tide effluent pumps, is indicating the pump discharge rate which includes both sewage flow and tidal backup.

The separate sewage collection system, built in 1894, serve approximately 80% of the Borough's population. With the exception of one pumping station which serves approximately 100 homes, the system is gravity. No known bypasses exist in the collection system. The plant bypass, located in a manhole in the street adjacent to treatment facility, has not been used in many years, as shown by the fact that the manhole cover is sealed with several layers of asphalt paving material.

Infiltration into the system is considered to be insignificant by Borough officials. Project personnel, however, have observed flow increases during and after rain storms. No reliable estimate of the magnitude of infiltration can be made since the plant's flow measuring device is either recording inaccurately or out of order completely.

### Treatment

Primary treatment of sewage is provided by four single story sedimentation (septic) tanks followed by chlorination. No preliminary treatment - screening or grit removal - has been provided. Sludge is dewatered on glass-covered drying beds.

Effluent discharges directly into Sandy Hook Bay at a point approximately 1,000 feet offshore. During periods of low tide, effluent flows by gravity through the outfall. During high tide, an automatic tide gate goes into operation. When the sewage in the plant backs up, due to the closed gate, float-controlled pumps in the chlorine contact tank are actuated. These pumps bypass the tide gate and provide the additional head needed to overcome the backup in the outfall line.

## Findings

New Jersey State Health Department's Rules and Regulations for the Design of Sewerage Facilities (Section 11.3b) states that for single story settling tanks, without sludge digestion, the capacity, exclusive of sludge capacity, shall be such as to provide at least eight hours detention time, based on design flow. Under normal conditions at Atlantic Highlands, two of the four tanks are operated in parallel for 30 to 40 days while the remaining two tanks are being cleaned. Based on an average daily flow of 590,000 gallons the detention period is slightly more than 6.6 hours.

### Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **24 hour studies** | | | | | | |
| 8-23,24-62 | - | 72 | 28 | 91 | 23 | 96 |
| 10-11,12-62 | 0.9 | 95 | 41 | 84 | 30 | 17 |
| 8-15,16-63 | 1.1 | 33 | 59 | 98 | 36 | 21 |
| 1-24,25-63 | 0.9 | 34 | 60 | 58 | 44 | 0 |
| **Grab samples** | | | | | | |
| 8-7-62 to 9-11-63 (50 samples) | - | 53 | - | 125 | - | 8 |
| 10-6-64 to 12-21-65 (14 samples) | 0.7 | 64 | - | 90 | - | 0 |
| 1-18-66 to 5-18-66 (5 samples) | 0.8 | 60 | - | 56 | - | 0 |

Results of the comprehensive day-long investigations show that the plant failed to meet, with the exception of one study which was just borderline, the ISC requirement of 60% removal of suspended solids. Bacteriologically, the installation only failed to meet the ISC coliform requirements during one of the 24-hour studies.

From data obtained, it is evident that the plant relies heavily upon chlorination to provide the final stages of treatment. The problem associated with this type of operation is that since the control of the application of chlorine is poor, dosages during certain high load or flow periods may very well be insufficient to provide the required kill. For example: During the 24-hour study in

October 1962, coliform counts as high as 160,000 per 100 ml were recorded during the high flow periods - (8 a.m. to 12 noon.)

The minimum standards for laboratory control, as set by the Conference of State Sanitary Engineers, are not met by this plant. Settleable solids, which should be run daily, is performed only three times per week.

Operation of the facility is presently restricted to one operator who spends approximately two hours per day at the plant. This man also reportedly returns every hour during the period of 8 a.m. to 4 p.m., to take a chlorine residual. The standards recommend a minimum of one full time operator and one half time laborer.

Poor records of plant operation and tests performed are maintained. The standards recommend keeping an accurate daily-type log book and a tabular record of tests performed.

## LEONARDO U.S. NAVAL AMMUNITION DEPOT

### Background

This 20 year old intermediate treatment plant, located on the ammunition depot at Leonardo, N.J., serves 75 people. A separate sewer system, covering an area of approximately 900,000 square feet, serves the plant.

### Treatment

Treatment includes screening, sedimentation (Imhoff tank), sand filtration and pre and post-chlorination. Effluent is discharged to a storm water chamber which empties into Wierd Creek, a small tributary to Raritan Bay.

### Findings

Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| 24 hour study<br>9-8,9-64 | .005E | 7* | - | 10.0 | - | 4 |
| Grab samples<br>10-6-64 to 12-21-65<br>(14 samples) | .005E | 19 | 84 | 12 | 92 | 14 |
| 1-18-66 to 5-18-66<br>(5 samples) | .005E | 10 | 87 | 24 | 81 | 0 |

*Based on 13 samples

Data collected by the Project indicates that the effluent meets both the suspended solids and bacteriological standards of the Compact. The plant, as presently operated, is underloaded. The dosing syphons for the sand filters trip only once every 28 to 30 hours. Correspondingly, results for BOD and suspended solids removal are high.

## KEANSBURG

### Background

The Borough of Keansburg, N.J., located on the southern shore of Raritan Bay approximately seven miles east of the Raritan River, provides primary treatment for its domestic and commercial wastes. The plant handles wastes from a winter tributary population of 7,500 people. During the summer months, however, the weekday population is approximately 16,000 and the weekend peaks at about 25,000 people.

The community's original treatment installation, constructed in the early 1900's, was replaced by a new 2.0 MGD facility, providing chemical treatment and chlorination, in 1949-50. However, except for a short start-up period, chemicals have never been used. In August 1963, Keansburg was awarded a $90,000 FWPCA construction grant. The installation of two new flocculation-sedimentation units — identical in size and shape to the two existing facilities, chlorine contact tank, and a flash mixer was completed in 1965.

The new installation is designed for a 1970 maximum flow of 3.2 MGD; which includes an allowance of 0.7 MGD for infiltration. Presently, the average flow during the winter months is approximately 1.7 MGD. During the weekday summer periods the Project has observed the average flow to be 2.9 MGD, with peak hourly rates reaching as high as 3.1 MGD.

The present plant site is subject to flooding during heavy storm periods; therefore, emergency flood doors have been provided in the main building to protect mechanical equipment. In past years, the plant has been forced to shut down several times due to flooding conditions.

Wastes are conveyed to the treatment plant by gravity through a separate sewer system constructed in 1900. Infiltration is estimated to be 0.5 to 0.7 MGD. With the exception of the treatment plant, there are no known bypasses in the system. At the plant all flow must pass the chlorination point before discharge.

### Treatment

Primary treatment consisting of screening, grit removal, sedimentation and chlorination, is provided at Keansburg. Chemical feeding equipment for adding lime and ferric chloride to the raw wastes have been provided, however, it is presently not used. Sludge is digested in a single tank and dewatered on a rotary vacuum drum-type filter. Scum which accumulates on the settling tanks is pumped to the digester. Effluent is discharged into Raritan Bay through a 24-inch diameter line which terminates approximately 2,200 feet offshore.

## Findings

### Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| 24 hour studies | | | | | | |
| 8-30,31-62 | 2.9 | 73 | 55 | 63 | 22 | 92 |
| 10-25,26-62 | 1.7 | 58 | 24 | 56 | 28 | 36 |
| 1-17,18-63 | 1.4 | 78 | Neg | 56 | 22 | 42 |
| Grab Samples | | | | | | |
| 8-7-62 to 9-11-63 (47 samples) | - | 62 | -- | 85 | -- | 58 |
| 10-14-64 to 6-24-65 (7 samples) | 1.3 | 74 | -- | 42 | -- | 29 |
| 1-18-66 to 5-18-66 (5 samples) | 1.3 | 64 | -- | 31 | -- | 20 |

During 1962 and 1963 the Project conducted three 24-hour investigations. The plant failed to meet ISC solids removal requirements during all of these studies — in one case a negative removal was recorded. ISC has also reported finding negative removals during their investigations.

Based on Project observations it is felt that a contributing factor to the small solids removal is the uncontrolled release of supernatant from the digester, which causes overloading of the system. This condition has been noticed as recently as August 1966.

Bacteriologically, only one of the three 24-hour studies failed to meet the Compact coliform requirements. However, for the grab samples collected during '62 and '63, 27 out of 47, or approximately 58%, had a coliform count of greater than one per ml. This fact gives further proof to Project observations that treatment at this plant improves with the duration of the investigation, and that this higher degree of treatment is not duplicated in unannounced grab samples.

A review of plant operating records reveals that the plant performs the following tests: Chlorine residual - every two hours; settleable solids - three times per day. Laboratory control procedures carried out at Keansburg are below the minimum standards set by the Conference of State Sanitary Engineers. The plant fails to meet the following recommendations: BOD and suspended solids of raw and final - once per week; and pH and total solids of digested sludge - when sludge is drawn.

# KEYPORT

## Background

Borough of Keyport, N.J., is located on the southern shore of Raritan Bay, approximately five miles east of the mouth of the Raritan River. The original wastewater treatment facility was constructed in 1929, and expanded in 1936 to handle a design flow of 0.4 MGD. In 1961-62 the facility underwent extensive reconstruction. This expansion program included a new grit removal device, settling tank, digester and vacuum filter. The old sedimentation tank, digester and glass-covered drying beds are now on stand-by status. The original chlorine contact tank was also rebuilt during this period.

The treatment installation serves an area of approximately one square mile, and the tributary population, exclusive of seasonal fluctuations, is estimated at 7,000 people. The summer influx is estimated at 500 to 1,000 persons. Flow from industries is considered negligible.

The sanitary sewer system is provided with three pumping stations. Only one of the installations, South Keyport, is designed for bypassing. Raw sewage discharges from this lift station would empty into Chinkarora Creek.

## Treatment

Primary treatment — pre-chlorination, screening, grit removal, sedimentation, digestion, vacuum filtration, post-chlorination — is provided for a design flow of 1.0 MGD. The maximum design flow is 4.0 MGD. Treated sewage is discharged through a 24-inch diameter pipe extending approximately 140 feet into Raritan Bay.

## Findings

A review of plant flow records for the past several years reveals that the flow is gradually approaching the design rate of 1.0 MGD. During the July 1964, 24-hour study, the average flow was 0.99 MGD. During 12 out of the 24 hours, the flow rate was equal to, or exceeded the design value. If this flow increase continues in the same pattern as in past years, it is estimated that the plant might very well exceed its design capacity sometime during 1967.

## Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **24-hour studies** | | | | | | |
| 11-1,2-62 | 0.7 | 46 | 66 | 131 | 25 | 20 |
| 12-13,14-62 | 0.8 | 32 | 65 | 103 | 34 | 8 |
| 1-31,2-1-63 | 0.7 | 67 | 44 | 101 | 38 | 0 |
| 7-13,14-64 | 1.0 | 108 | 46 | 87 | 38 | 46 |
| **Grab Samples** | | | | | | |
| 8-7-62 to 9-11-63 (44 samples) | - | 56 | - | 156 | - | 25 |
| 10-14-64 to 12-21-65 (14 samples) | 0.9 | 49 | - | 81 | - | 7 |
| 12-27-65 to 5-18-66 (5 samples) | 0.9 | 75 | - | 64 | - | 20 |

It is evident that the plant, even though constructed in 1962, is not complying completely with ISC standards for solids removal. On two occasions it failed to meet the minimum 60% removal rate.

The effluent during all 24-hour studies met ISC coliform standards. It is noteworthy to point out, that although 13 out of the 24 samples collected on July 13-14, 1964 had a coliform count of less than one per ml, the geometric mean for all 24 samples was 270 coliform organisms per 100 ml.

Laboratory control procedures at Keyport are below the minimum standards set by the Conference of State Sanitary Engineers. The plant performs the following tests: pH of digested sludge - daily; chlorine residual - four times per day. It is recommended that for this size plant the following additional tests be performed: settleable solids - daily; BOD and suspended solids of raw and final effluent - once per week; total solids of digested sludge — when sludge is drawn.

It is further recommended that at least two operators, one laborer, and six hours per week of administrative supervision be provided. Keyport presently has only one operator; other personnel requirements are met.

## MATAWAN BOROUGH

### Background

The treatment facility serving Matawan Borough, N.J., was originally constructed in 1923. During 1962 this installation was replaced with a modern, 0.8 MGD primary plant.

Municipal sewage is conveyed to the treatment facility by a separate sewer system, constructed in 1923. Infiltration appears to be a problem, since flow increases significantly during storm periods. Four pumping stations, none of which are provided with a bypass, serve a portion of the system.

### Treatment

Treatment includes screening, grit removal, sedimentation-digestion (clarigester) and pre and post chlorination. Sludge is dried on two beds, one of which is covered. Effluent is discharged through an 18-inch outfall into Matawan Creek, a minor tributary to Raritan Bay. By-passing of the plant, during emergency periods, is possible.

### Findings

Performance Summary

| Date | Flow mgd | Sus Solids | | BOD | | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| | | Eff mg/l | %Rem | Eff mg/l | %Rem | |
| 24 hour study | | | | | | |
| 7-15,16-64 | 0.8 | 82 | 36 | 80 | 39 | 4 |
| Grab Samples | | | | | | |
| 8-13-63 to 8-28-63 (3 samples) | - | 59 | - | 139 | - | 0 |
| 10-6-64 to 12-21-65 (14 samples) | 0.8 | 30 | - | 135 | - | 21 |
| 1-18-66 to 5-18-66 (5 samples) | 1.0 | 118 | - | 103 | - | 20 |

Results of a 24-hour study conducted by the Project, in July 1964, indicated that the effluent did not meet the Compact standards of 60% removal of suspended solids. Bacteriologically, the effluent met the requirements. During the period August 1963 to May 1966, four of the 22 grab samples collected of the effluent had a coliform count of greater than one per ml.

The plant, as presently operated, meets the minimum standards, as set by the Conference of State Sanitary Engineers, for personnel and record keeping. It falls short, however, on laboratory operations, since the plant does not have facilities for analyzing for suspended solids and BOD.

## MATAWAN TOWNSHIP

### Background

The Matawan Township, N.J., wastewater treatment facility provides secondary treatment for approximately 1,000 persons in the River Gardens section of the community. The installation, constructed in 1953, handles an average daily flow of 80,000 gallons.

A separate sewer system, constructed in 1953, serves the area. One pumping station, serving approximately 80 homes - 250 people - has been provided. This lift station, equipped with screening devices, cannot be bypassed.

### Treatment

Treatment includes primary settling, aeration, secondary settling and chlorination. Sludge is digested in unheated tanks and dewatered in open sand beds. Effluent is discharged through an 8-inch outfall to Matawan Creek, a minor tributary to Raritan Bay.

### Findings

Although classified as a secondary plant, this installation during most visits by Project personnel was providing only primary treatment. This condition, which prevailed for almost two years (1964-1965), was usually caused by an inoperable blower system.

Performance Summary

| Date | Flow mgd | Sus Solids | | BOD | | Coliform % |
|---|---|---|---|---|---|---|
| | | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| 10-14-64 to 12-21-65 (13 samples) | 0.05E | 74 | 57 | 76 | 63 | 23 |
| 1-18-66 to 5-18-66 (5 samples) | 0.05E | 106 | 44 | 89 | 53 | 20 |

It appears, based on data obtained by the Raritan Bay Project, that this plant is not meeting the Compact requirement of 60% removal of suspended solids.

Bacteriologically, however, the effluent had a count of greater than one coliform per ml in only four out of 18 samples. Data collected indicates that chlorination is relied upon heavily to provide an adequate degree of treatment. Since the plant is manned only two to three hours per day, and because the control of the application of chlorine is poor, the dosage applied during peak flow periods might very well be inadequate. Case in point: All samples with a coliform count of greater than one per ml were taken between the hours of 9:00 and 10:30 a.m.

The plant, as presently operated, does not meet the minimum requirements for laboratory control, as recommended by the Conference of State Sanitary Engineers. No determinations are made for sludge index or dissolved oxygen of the mixed liquor. Minimum personnel requirements are met; however record keeping falls short of the desired recommendations.

# LAURENCE HARBOR (MADISON TOWNSHIP)

## Background

The Laurence Harbor, N.J., wastewater treatment installation, previously known as the Knollcroft Plant, was constructed in 1960. The original 0.2 MGD installation, designed to serve a population of approximately 850 people, provided primary treatment consisting of screening, settling, chlorination, digestion, and sludge drying in lagoons.

In 1963 the plant was replaced by a modern 1.2 MGD primary treatment installation. New facilities included screening, grit removal, settling, pre-and post-chlorination, digestion and sludge dewatering by vacuum filter. The only structure retained from the old plant was a digester which was converted into a sludge storage tank. The new complex, which is ultimately designed to serve approximately 3,500 homes, is presently handling wastes from 1,000 homes, representing a tributary population of about 3,500 people and a flow of about 0.5 MGD. Reportedly, there is no change in the population during the summer months. Bypassing of raw sewage at the plant is possible; however, wastes must pass the chlorine application point.

The separate sewer system, serving Laurence Harbor and Cliffwood Beach, N.J., is essentially gravity with the exception of two pumping stations which serve small portions of each area. Township officials claim that approximately 65% of the sewage comes from Laurence Harbor and the remainder from Cliffwood Beach. These automatically controlled pumping stations reportedly cannot be bypassed. Infiltration into the four-year-old sewer system is claimed to be negligible.

## Treatment

Facilities include a bar screen, grit chamber, two mechanically cleaned sedimentation tanks, chlorine contact tank, two digesters, sludge storage tank and a vacuum filter. The chlorination features of the plant are above average. In addition to practicing pre-and post-chlorination, the plant is equipped with a continual residual chlorine indicator-recorder which is tied back to the feed rate. Another feature of the plant is the digester gas mixing and recirculation system.

Reportedly, the sludge dewatering equipment —— a rotary drum-type vacuum filter —— has never been used due to the lack of adequate quantities of sludge. Under normal operations dewatered sludge would be trucked away.

Effluent from the plant discharges directly into Raritan Bay through an outfall line which terminates at a point approximately 1,000 feet offshore.

## Findings

The Raritan Bay Project, since August 29, 1963, has conducted three complete 24-hour studies and collected 22 grab samples of the effluent. A summary of the results of these investigations follows:

### Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **24 hour studies** | | | | | | |
| 8-29,30-63 | 0.2 | 81 | 62 | 145 | 49 | 21 |
| 7-7,8-64 | 0.4 | 52 | 64 | 125 | 32 | 0 |
| 7-20,21-64 | 0.5 | 89 | 40 | 163 | 29 | 13 |
| **Grab Samples** | | | | | | |
| 8-13-63 to 8-28-63 (3 samples) | 0.4 | 42 | - | 170 | - | 0 |
| 10-6-64 to 12-21-65 (14 samples) | 0.6 | 101 | | 135 | - | 14 |
| 1-18-66 to 5-18-66 (5 samples) | 0.6 | 99 | - | 95 | - | 0 |

The plant met ISC standards for solids removal during two of three 24-hour studies. Bacteriologically, the effluent, during all studies — 24-hour and grab — had a count of less than one coliform per ml in more than 50 percent of the samples. It would appear, based on these data, that the plant is discharging an effluent of a quality commensurate with the degree of treatment provided.

The only area where the plant falls short of the recommendations of the Conference of State Sanitary Engineers is in laboratory control. The standards suggest that total solids of digested sludge be run whenever sludge is drawn. Since the plant does not have the proper equipment, they are unable to perform this test.

## SAYREVILLE-MORGAN

### Background

The Sayreville sewer system is divided into three separate sections, each discharging to a different wastewater treatment plant - Sayreville-Morgan, Sayreville-Melrose, and Middlesex County Sewerage Authority. The system as a whole serves an area of 15 square miles and a population of 22,600 people.

The Morgan installation, constructed in 1952, is located in the Morgan Section of Sayreville, N.J. It provides primary treatment for an average flow of 0.2 MGD and a population of 2,000. The facility is designed for a tributary population of 3,000 people and a flow of 0.3 MGD. The plant can be bypassed, with the sewage being discharged 500 feet west of the plant to a gully which flows into Raritan Bay. During storm periods the installation is subject to flooding, and as a result, has at times been forced to shut down.

The sanitary sewer system serving the plant was constructed in 1920. Reportedly, infiltration is not a problem.

### Treatment

Treatment consists of screening, sedimentation and chlorination - both pre and post. Sludge is digested in unheated tanks and dewatered in glass-covered drying beds. Effluent is discharged through a outfall line extending approximately 1,000 feet into Raritan Bay.

### Findings

Based on the present average daily flow detention time in the two sedimentation units approaches 6.0 hours. During the summer months this long holding period causes septic conditions; as a result, only one tank is operated during the warmer periods. This type of operation, which was suggested by the N.J. State Health Department, has reportedly eliminated the septicity problem.

During the period June to August 1964, a representative of the Raritan Bay Project visited the Morgan plant on three different occasions. During all inspections the plant was found to be rundown and inadequately maintained. Such things as a major leak in the outfall line, leaking valves in the digester and a broken concrete weir in the chlorine contact tank were observed during all visits.

### Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **8 hour study** | | | | | | |
| 7-27-64 | 0.2 | 88 | 77 | 212 | 28 | 33 |
| **Grab Samples** | | | | | | |
| 10-6-64 to 12-21-65 (14 samples) | 0.2 | 94 | | 198 | | 21 |
| 12-27-65 to 8-1-66 (5 samples) | 0.2 | 84 | | 130 | | 0 |

On July 27, 1964 an 8-hour study was conducted at the plant by Project personnel. For this period the solids removal averaged 77% and the BOD removal 28%. Bacteriologically, six out of the nine effluent samples had a count of less than one coliform per ml.

During this investigation two different methods - amperometric and colorimetric - were utilized for determining the chlorine residual. Results of this study follow:

| Time | Chlorine Residual (mg/l) Colorimetric | Chlorine Residual (mg/l) Amperometric Titration | Coliform /100 ml |
|---|---|---|---|
| 8:05 | 10.0+ | 20.64 | 10 |
| 9:05 | 10.0+ | 17.98 | 30 |
| 10:00 | 5.0 | 11.79 | 10 |
| 11:00 | 0.0 | 2.30 | 560 |
| 12:00 | 2.0 | 5.41 | 260 |
| 13:00 | 3.75 | 6.75 | 520 |
| 14:00 | 5.0 | 9.23 | 30 |
| 15:00 | 10.0 | 12.82 | 20 |
| 16:00 | 10.0 | 15.02 | 10 |

It would appear, based on this preliminary study and past observations, that the plant relies heavily upon chlorination to provide an adequate degree of treatment. Since the control of the application of chlorine is poor the dosage applied during periods of high flow is inadequate. This condition is brought out in the data for the period between 11:00 to 13:00. Also, it would seem, based on this investigation, economically advantageous for the municipality to adopt the more reliable amperometric method for determining chlorine residual.

## SOUTH AMBOY

### Background

The South Amboy wastewater treatment plant, owned and operated by the City of South Amboy, N.J., was constructed in 1939 to accommodate a design flow of 1.0 MGD. The primary installation is presently serving an estimated population of 8,400 people, and treating approximately 0.85 to 0.9 MGD.

The separate-type sewer system, serving the whole municipality with the exception of one block, has five pumping stations - Raritan Street, Lower Pine Avenue, Lower Broadway, South Amboy and Thomas Street. Reportedly none of these lift stations, which handle wastes from a tributary population of 800 — 1,000 people, are provided with bypasses. The only known bypass is at the treatment plant. Infiltration into the 25-year old sewer system is claimed to be a problem.

### Treatment

Facilities include a bar screen, two circular primary sedimentation tanks, chlorine contact tank, two digesters and a vacuum filter. Effluent from the plant is discharged offshore into Raritan Bay. Bypassed sewage is discharged at the same location.

### Findings

Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| **24 hour studies** | | | | | | |
| 7-19,20-62 | 0.9 | - | - | - | - | 6 |
| 9-6,7-62 | 0.9 | 42 | 76 | 117 | 18 | 33 |
| 11-15,16-62 | 0.9 | 56 | 64 | 136 | 21 | 21 |
| 5-26,27-64 | 0.8 | 41 | 81 | 70 | 26 | 0 |
| **Grab Samples** | | | | | | |
| 8-7-62 to 9-11-63 (47 samples) | | 59 | | 154 | | 17 |
| 9-28-64 to 12-27-65 (14 samples) | 1.3 | 75 | | 177 | | 0 |
| 12-28-65 to 5-18-66 (5 samples) | 0.8 | 115 | | 138 | | 0 |

The South Amboy plant, as presently operated, does not meet the minimum requirements for laboratory control as recommended by the Conference of State Sanitary Engineers. The only test performed at the plant is chlorine residual. Recommended is the following: Settleable solids - daily; pH of raw sewage - occasionally; total solids, digested sludge - when sludge is drawn. The installation satisfies the minimum requirements for personnel and approaches the minimum standards for record keeping.

It appears, based on observations by Project personnel, that even though the plant's performance record —— solids and bacteriological —— met ISC requirements during all visitations, the installation is not operated or maintained effectively. Improper operation of the digesters —— hung-up floating cover, bad seal, unrestricted use of lime, insufficient laboratory analyses; and uneven flow from the sedimentation basins —— due to accumulations of grease on the effluent weirs, has been noted.

## MIDDLESEX COUNTY SEWERAGE AUTHORITY

### Background

Middlesex County Sewerage Authority was created in 1950; by early 1966 the Authority included 18 municipal and eight industrial participants, representing an area of 96 square miles and a tributary population of 331,000, exclusive of industry. Construction of a central chemical treatment plant was begun in 1955 and the facility was placed in operation in January 1958. Design capacity at that time was 52 MGD. In early 1966, the Authority completed a million dollar expansion program which increased the design capacity to an average flow of 78 MGD and a peak flow of 115 MGD.

The sewerage system consists of the main trunk sewer which runs parallel to the Raritan River, the South River interceptor, and the Sayreville and Heyden pumping stations and force mains. In addition, the system contains the necessary connections to the various participants, a small pumping station in Bound Brook, and metering facilities for each participant. Many of the systems which discharge to the Authority's sewers have overflow devices. The sole overflow in the Authority's trunk sewer is at Landing Lane and is presently locked to prevent discharging.

Raw sewage by-passes are provided at the Sayreville and Bound Brook pumping stations and at the treatment plant. The Sayreville by-pass is designed to discharge to Washington Canal; Bound Brook to the Raritan River. Neither by-pass has ever been used. At the treatment plant the by-pass runs from the grit chamber to the post-chlorination facilities.

### Treatment

Waste (43 MGD) are conveyed to the plant via the Sayreville pumping station and an additional 2 MGD is pumped to the plant from the Heyden station. The Bound Brook station discharges 0.1 MGD to the main trunk sewer. Both the main sewer and the South River interceptor connect to the Sayreville station. All three pumping stations provide screening; in addition, the Heyden and Bound Brook stations are equipped with comminuting devices.

Treatment at the central plant consists of pre-chlorination, grit removal, flocculation, sedimentation, post-chlorination, and sludge thickening. There are no digestion facilities; sludge and grit are loaded on barges for ocean disposal. The plant effluent is discharged to a point approximately 1.5 miles in Raritan Bay.

The plant has a capacity for feeding lime and chlorinated copperas. However, except for a short period during the initial start-up of the plant, chemicals have not been used for treatment since Interstate Sanitation Commission standards for solids removal reportedly can be met without chemical addition.

## Findings

### Performance Summary

| Date | Flow | Sus Solids | | BOD | | Coliform % |
|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| **24 hour studies** | | | | | | |
| 8-16,17-62 | 40.8 | 74 | 80 | 560 | 17 | 88 |
| 9-20,21-62 | 40.0 | 86 | 77 | 558 | 15 | 29 |
| 11-29,30-62 | 48.0 | 110 | 72 | 402 | 10 | 8 |
| 5-20,21-64 | 48.5 | 57 | 80 | 458 | 16 | 4 |
| **Grab Samples** | | | | | | |
| 8-7-62 to 9-11-63 (49 samples) | 45.5 | 89 | | 449 | | 32 |
| 9-28-64 to 12-27-65 (14 samples) | 51.1 | 107 | | 396 | | 36 |
| 12-28-65 to 5-18-66 (5 samples) | 51.5 | 127 | | 369 | | 40 |

During all four 24-hour studies solids removal exceeded the Interstate Sanitation Commission requirements. With the exception of the August 1962 study, effluent coliform counts during the 24-hour investigations were less than 1 per ml, 50% of the time.

A review of coliform counts and chlorine residual data indicates that frequently good bacteria kills were recorded with apparently little or no chlorine residual. Due to the high color of the effluent, a study was undertaken to determine the accuracy of the colorimetric method for chlorine residual. A comparison of residual chlorine by colorimetric and amperometric titration methods for the 24-hour study of May 1964 are as follows:

**Chlorine Residual (Total - mg/l)**

| Time | Colorimetric | Titrator | Coliform per 100 ml |
|---|---|---|---|
| 11:00 | 5.0 | 7.9 | 10 |
| 12:00 | 2.5 | 5.4 | 10 |
| 13:00 | 0.0 | 2.1 | 10 |
| 14:00 | 2.5 | 6.6 | 10 |
| 15:00 | 1.5 | 6.6 | 200 |
| 16:00 | 1.0 | 5.7 | 10 |
| 17:00 | 0.0 | 5.2 | 40 |
| 18:00 | 0.5 | 5.0 | 10 |
| 19:00 | 0.0 | 2.0 | 10 |
| 20:00 | 0.1 | 4.0 | 10 |
| 21:00 | 0.1 | 4.5 | 10 |
| 22:00 | 0.25 | 3.8 | 10 |
| 23:00 | - | 2.6 | 30 |
| 24:00 | 0.35 | 4.4 | 20 |
| 1:00 | - | 4.7 | 10 |
| 2:00 | 0.20 | 3.6 | 10 |
| 3:00 | - | 3.8 | 10 |
| 4:00 | 0.60 | 4.7 | 10 |
| 5:00 | - | 4.8 | 10 |
| 6:00 | 2.5 | 5.8 | 10 |
| 7:00 | - | 3.0 | 10 |
| 8:00 | 0.25 | 2.5 | 10 |
| 9:00 | - | 4.9 | 10 |
| 10:00 | 0.25 | 3.6 | 10 |

These data suggest the amperometric method would be a more reliable technique.

As presently operated the plant more than meets the minimum requirements for operating personnel, laboratory procedures and records, as recommended by the Conference of State Sanitary Engineers.

Project investigations have shown that BOD removals at this plant vary from 10 to 17%. This low removal is attributed to high dissolved BOD which is present in the industrial wastes handled. Even with the sophisticated chlorination facilities available, effluent from this plant results in a large BOD load on Raritan Bay. As shown in Table III more than 90% of the BOD load to the Bay from municipal plants originates from the Middlesex County Sewerage Authority discharge.

## PERTH AMBOY

### Background

Perth Amboy, N.J., located at the junction of the Arthur Kill and Raritan River, provides primary treatment for municipal and industrial wastes. During the summer bathing season chemicals are added for increased removals. The 10 MGD plant, constructed in 1934, is designed to serve a population of 50,000 people The existing tributary population is estimated at 38,000 people and the present flow averages approximately 6.2 MGD. The only additions to the plant since construction has been the installation, in 1956, of sludge dewatering equipment.

The treatment facility, which can be bypassed, discharges at a point 200 feet offshore of the plant site into Raritan Bay. This location is approximately the center of the former public bathing beach of the City of Perth Amboy.

The combined sewer system, serving approximately six square miles, was constructed in 1935 and improved in 1954. There are a total of 18 stormwater overflows in the system -- eight discharging to the Raritan River and 10 to the Arthur Kill. These leaping weir devices are designed to bypass all flows in excess of 1.6 times the average dry weather flow.

Approximately 30% of the municipality's wastes are pumped to the plant by two lift stations - State Street and Front Street. Bypasses are provided at each location with the discharge emptying into the Arthur Kill.

### Treatment

Facilities at Perth Amboy include two hand cleaned bar screens, a pre-aeration mixing chamber, two circular primary sedimentation basins equipped with upward--flow magnetite filters, chlorine contact tank, and two vacuum filters for sludge dewatering. Lime and ferric chloride, used for conditioning the sludge prior to dewatering, are also added to the raw sewage during the bathing season -- May 15 to September 15, during the hours of 7 a.m. to 7 p.m.

### Findings

Magnetite filters at Perth Amboy were originally designed to provide increased removals of colloidal and finely divided suspended solids normally present in the primary effluent. The units had the capacity to handle up to 7 MGD before bypassing to the effluent launder of the settling tanks. However, in early 1960, because of hydraulic limitations and clogged conditions, a series of relief pipes were installed to permit bypassing of primary effluent around the filter beds. This bypassing of a treatment unit has little significance since the State of New Jersey "does not recognize magnetite filters as a treatment method." (Chapter 6.1 - Rules and Regulations for the Design of Sewerage, Water Treatment and Supply Facilities.

Performance Summary

| Date | Flow | Sus Solids | | BOD | | Coliform % |
|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| 24 hour studies | | | | | | |
| 7-26,27-62 | 5.6 | | | | | 10 |
| 9-13,14-62 | 6.8 | 66 | 61 | 193 | 34 | 29 |
| 11-8,9-62 | 5.7 | 84 | 56 | 188 | 0 | 8 |
| 9-12,13-63 | 7.4 | | | 111 | 43 | 63 |
| 5-7,8-64 | 4.9 | 27 | 72 | 143 | 7 | 21 |
| Grab Samples | | | | | | |
| 8-7-62 to 9-11-63 (48 samples) | 7.3 | 74 | | 160 | | 56 |
| 9-28-64 to 12-27-65 (12 samples) | 6.7 | 117 | | 202 | | 42 |
| 12-28-65 to 5-18-66 (5 samples) | 6.8 | 119 | | 166 | | 60 |

Perth Amboy, during one of the three 24 hour studies, where solids data were collected, failed to meet the ISC standards of 60% removal. Bacteriologically, Compact requirements of less than one coliform per ml 50% of the time, were met during four out of five 24--hour studies. It is noteworthy to point out that the degree of treatment at this plant, which generally increases with the duration of the test period, is not usually duplicated when unannounced random samples are obtained. Case in point: 56% of the 48 samples collected from 8-7-62 to 9-11-63 had a coliform count of greater than one per ml.

Visits to the plant by Raritan Bay Project personnel have indicated that this installation is presently inadequately maintained. During all visits massive grease accumulations and scum mats were noticed on the surface of the settling and pre-aeration tanks. As a result, odorous conditions existed in and around the treatment facility. Also noted were inoperable or clogged air headers in the mixing basin.

The treatment facility, as presently operated does not meet all of the minimum requirements for laboratory control, records, and personnel, as recommended by the Conference of State Sanitary Engineers. BOD of the raw wastes and effluent are run only twice per week - recommended is once daily. Laboratory data, while maintained in a tabular form, were very spotty and gaps of several weeks, where no data were recorded, were noted. For this size plant a minimum of six operators is recommended - Perth Amboy has three.

The treatment facility, as presently operated does not meet all of the minimum requirements for laboratory control, records, and personnel, as recommended by the Conference of State Sanitary Engineers. BOD of the raw wastes and effluent are run only twice per week - recommended is once daily. Laboratory data, while maintained in a tabular form, were very spotty and gaps of several weeks, where no data were recorded, were noted. For this size plant a minimum of six operators is recommended - Perth Amboy has three.

## JUNIOR HIGH SCHOOL NO. 7

### Background

During the latter part of 1963 construction was started by the New York City Board of Education on a Junior High School, located on Hylan Boulevard and Huguenot Avenue, Staten Island, N.Y. The facility, which opened in September 1965, is served by a packaged extended aeration plant and sub-surface sand filters.

The treatment installation, designed for a normal flow of 15,000 gpd (2,000 gph on a 7½ hour basis), can handle wastes from a contributing population of 2,128 people - 2,088 pupils, 66 teachers and 34 maintenance personnel. Flow during the summer months, due to the school's playground and comfort station, is expected to reach 3,000 gpd.

### Treatment

Sewage from the upper floors flows to the pumping station by gravity. Wastes from the ground floor and basement, however, flow to a sump in the basement where it is pumped to a manhole in front of the school for gravity flow to the pumping station. All sewage is comminuted prior to entering the wet well, which reportedly has sufficient storage capacity to handle peak flows. Wastes are then pumped to the diversion box where flows in excess of the design rate are returned to the wet well.

After aeration for a period of 24 hours the mixed liquor is settled. Settled sludge is continuously returned by an air lift pump to the aeration tank. Clarified effluent flows to the froth pump wet well, which is a source of water for the froth control spray system. Overflow from the well empties into a dosing tank where alternating siphons discharge sewage onto three sand filters, each 17 x 30 feet. Effluent from the beds is conveyed to the chlorine contact tank prior to its discharge to a storm sewer which empties into Raritan Bay. In the event of a plant shutdown, wastes can bypass the activated sludge unit but not the sand filters and chlorination facilities. Sludge from the holding tank is trucked away and disposed of at the Oakwood Beach Pollution Control Project.

### Findings

During the period from Oct. 19, 1966 to August 1966, residuals averaged 2.0 mg/l, with the minimum being 0.6 and the maximum 3.0. Performance data other than seven chlorine residuals collected by the New York City Health Department, are not available.

## MOUNT LORETTO

### Background

This home and school, owned and operated by the Mission of the Immaculate Virgin, is located on Hylan Boulevard between Richard and Sharrot Avenues, Staten Island, N.Y. The facility, which covers an area of 895 acres, is served by two separate sewage disposal systems — one serving the girls' section on the south side of Hylan Blvd.; and the other the boys' section on the north side of Hylan Blvd.

The population served by these treatment facilities is 1,179 people; 415 for the girls' section and 764 for the boys' system. Since no flow indicating or recording devices are available, it is estimated that the average flow from the girls' system is 45,000 gpd and 81,000 gpd from the boys' section.

In April 1962 an order to abate pollution was issued by the New York City Health Department. In 1963 this was complied with by the installation of an automatic hypochlorinator in the girls' section and the installation of a chlorine contact tank and an automatic hypochlorinator in the boys' system.

### Treatment

Boys' Section: Facilities consist of one 81,000 gallon capacity septic tank and a 3,600 gallon chlorine contact tank. Contact time is estimated at 35 minutes with an additional 10 minutes in the outfall line, which terminates on the shore line of Raritan Bay.

During periods of cleaning, which occurs once every three to five years, the system bypasses raw sewage to the Bay.

Girls' Section: Facilities include two 22,500 gallon capacity septic tanks and one 2,000 gallon chlorine contact tank. Contact time is estimated at 35 minutes. Effluent is discharged through an 18-inch outfall line which discharges at the shore line of Raritan Bay.

**Findings**

The following data were collected by the New York City Health Department (1963-64) and ISC (1965-66)

| Plant | Date | Coliform/ml | Chlorine Residual(mg/l) |
|---|---|---|---|
| Girls' | 5-31-63 | 240,000 | 0 |
| | 6-19-63 | 160,000 | 0 |
| | 10-29-63 | 92,000 | 0 |
| | 1-8-64 | < 1 | 0 |
| | 3-16-64 | 70 | --- |
| | 4-14-64 | > 1 | 0 |
| | 5-12-64 | 2,400 | 0 |
| | 6-17-64 | 2,400 | 0 |
| | 7-15-64 | 920 | 0.5 |
| | 8-24-64 | 23 | 1.0 |
| | 8-27-64 | < 1 | 3.5 |
| | 9-10-64 | 2,400 | 0 |
| | 6-28-65 | 23 | 3.0 |
| | 8-15-66 | 240 | 3.0 |
| Boys' | 10-29-63 | > 1 | trace |
| | 6-19-63 | < 1 | 1 |
| | 5-31-63 | 92,000 | 0 |
| | 1-18-64 | 78,000 | 0 |
| | 3-16-64 | < 1 | --- |
| | 4-14-64 | 920 | 0 |
| | 5-12-64 | > 2,400 | 0 |
| | 6-17-64 | > 2,400 | 0 |
| | 7-15-64 | < 1 | 1.5 |
| | 8-24-64 | < 1 | 1.0 |
| | 8-27-64 | > 1 | 2.0 |
| | 9-10-64 | > 1 | 1.2 |
| | 6-28-65 | < 1 | 3.0 |
| | 8-15-66 | 240 | 0 |

It appears, based on these data, that both plants are not meeting the coliform requirements of the Compact. For the girls' system only 2 out of 14 samples, or 14 percent, had less than one coliform per ml. Performance of the boys' plant was equally poor with only 5 out of 14 samples with a coliform count of less than one per ml.

## RICHMOND MEMORIAL HOSPITAL

### Background

In 1927 a sewer system was installed to serve the hospital located in Princess Bay, Staten Island, N.Y., and several private homes in the immediate area. In 1936 a septic tank was placed in operation. Eighteen years later, in 1954, a hypochlorinator and a prefabricated chlorine contact tank were added.

The treatment facility, which is located at the corner of Seguine Avenue and Johnston Terrace, is susceptible to flooding during storm periods and unusually high tides.

At the present time, the treatment facility handles wastes from an estimated population of 360 people - 160 patients, 125 employees, 24 nurses and 16 men in residence, and 12 one-family homes.

In March 1962 the New York City Health Department issued an order to abate pollution. This was complied with in 1963 by improving the chlorination facilities.

### Treatment

A 9,800 gallon capacity cylindrical steel septic tank - 21 feet long and 9 feet in diameter - followed by a 500 gallon baffled steel chlorine contact tank provide treatment for the hospital's wastes. Effluent is discharged to Rum Creek, a tributary to Lemon Creek which empties into Raritan Bay.

Liquid bleach, sodium hypochlorite, is presently being used at the rate of 10 gpd for disinfection. It is estimated that the contact time is approximately 16 minutes.

See Performance Summary on next page

## Findings

Results of investigation conducted by the Interstate Sanitation Commission and the N.Y.C. Department of Health follow:

| Sampling Agency | Date | Coliform/ml | Chlorine Residual(mg/1) |
|---|---|---|---|
| ISC | 8-16-61 | >1 | - |
| | 5-16-62 | >1 | - |
| | 8-14-62 | >1 | 0 |
| | 10-24-62 | >1 | 0 |
| | 5-11-64 | <1 | 0 |
| N.Y.C. Health Dept. | 1-8-64 | 200 | 1.5 |
| | 3-16-64 | 2400 | - |
| | 4-14-64 | 2400 | 0 |
| | 7-15-64 | 2400 | 0 |
| | 8-24-64 | 2400 | - |
| | 9-9-64 | 2400 | 0.2 |
| | 9-17-64 | <1 | 10+ |
| | 9-17-64 | <1 | 10+ |
| | 9-17-64 | <1 | 35 |
| | 9-17-64 | <1 | 35 |
| ISC | 6-28-65 | >1 | 0 |
| | 6-6-66 | >2400 | 0 |
| | 8-16-66 | >2400 | 0 |

It is evident that Richmond Memorial Hospital is not meeting the coliform requirements of the Compact. It is noteworthy to point out that the degree of treatment increases with the duration of the test period, and that this higher degree of treatment is usually not duplicated by unannounced grab samples. Case in point is the N.Y.C. Health Department eight hour test on 9-17-64, where all samples had less than one coliform per ml. All grab samples collected with only one exception, had a coliform count of greater than one per ml.

## DAYTOP LODGE (MARIST NOVITIATE)

### Background

The home of the Marist Novitiate on Bayview Avenue, Princess Bay, Staten Island, N.Y., is served by a septic tank system discharging into Lemon Creek. The Novitiate had a population of approximately 35 people.

In 1965 the property was sold to Daytop Village, Inc.; a group which established the property as a halfway house for drug addicts. Present permanent population at this location is estimated at 80 people. Daytime population may run as high as 200 people.

### Findings

Observations by Project personnel, and dye studies conducted by the New York City Health Department, indicate that the discharge line from the septic tank system is broken. Effluent, which is not chlorinated, is presently being discharged through an open ditch into Lemon Creek.

# MATAWAN TOWNSHIP: CLIFFWOOD BEACH PLANT #3

## Background

The Matawan Township sewage treatment plant No. 3 serves part of the Cliffwood Beach area and a small portion of Cliffwood across New Jersey State Highway 35. This facility, which began operations in January of 1966, provides secondary treatment for approximately 1,200 homes in the area. Designed for a flow of 0.65 MGD, this $500,000 plant is presently handling an average flow of 0.15 to 0.20 MGD. No seasonal fluctuations are expected at this plant.

The collection system is a separate sanitary system with no problems of infiltration reported. Approximately 65% of the influent to this plant is handled by five pumping stations, with the remaining influent gravity fed to the plant.

## Treatment

This plant is designed as a Rapid Block system, to treat sewage by the activated sludge process. Treatment includes a barminutor, an aerated de-gritter, three aerated primary settling basins, three aerobic digestion tanks, and a chlorine contact tank.

Grit is removed from the system and hauled away for landfill. Spent sludge from the activated sludge process will be pumped to four drying beds when sufficient sludge is accumulated. This dried sludge will be used in sanitary landfill operations.

The chlorinated effluent is discharged to an unnamed tributary to Whole Creek, a minor tributary to Raritan Bay.

## Findings

Two operators, only one of which is licensed, handle the plant. The licensed operator actually serves all three Matawan Township Plants, while the one unlicensed person maintains the plant and performs laboratory tests.

The laboratory facilities are presently performing analyses for BOD, suspended solids, settleable solids, dissolved oxygen, chlorine residual, pH, and relative stability.

Based on one grab sample the suspended solids removal average 89 percent. The coliform count of the effluent was 40 per 100 ml.

## ST. JOSEPH'S BY THE SEA

### Background

The Sisters of Charity, a Catholic order of nuns, owns and operates this convent and school, located at the southern end of Arbutus Avenue in Huguenot, Staten Island, N.Y. In September 1964 construction of a high school for girls was completed. The educational institution, located adjacent to the convent, is designed to serve an ultimate population of 910 people - 840 pupils, 40 nuns, 16 lay teachers, and 14 maintenance personnel.

### Treatment

Wastes from the high school and convent are conveyed to the treatment facilities through a 6-inch sewer. Effluent from the two parallel operated septic tanks, each of which measures 15 x 7 x 7.5 feet deep, is discharged into two sand filter beds. The subsurface beds each measure 60 x 155 x 3 feet deep. For disinfection, sodium hypochlorite solution is fed into a chlorine contact tank with a volume of 120 cubic feet. Based on the design flow of 900 gph the contact time is one hour. Chlorinated effluent flows by gravity through a 1,100 foot long, 6-inch diameter outfall line which terminates approximately 300 feet offshore in Raritan Bay. Reportedly, it is impossible to bypass the treatment facilities.

### Findings

Septic tank system serving old convent abandoned in 1965, when new facilities started operation.

| Sampling Agency | Date | Coliform/ml | Chlorine Residual(mg/l) |
|---|---|---|---|
| ISC | 6-18-65 | > 1 | 0 |
| | 6-13-66 | < 1 | 3.0 |

It would appear that this installation, when it maintains a sufficient residual, can meet the minimum coliform standards of the Compact.

# OAKWOOD BEACH

## Background

The Oakwood Beach pollution control project, owned and operated by the New York City Department of Public Works, is located on the eastern shore of Staten Island, N.Y., approximately one mile northeast of Great Kills Harbor. Wastes from the communities of New Dorp, Midland Beach, Oakwood and portions of Dongan Hills, South Beach, and Great Kills are conveyed to the treatment facility through a separate sewer system. Reportedly, no significant amounts of industrial wastes are handled.

The modified aeration plant, constructed in 1956, is designed to handle an average flow of 15 MGD. Four pumping stations, none of which can be bypassed, lift a portion (approximately 60%) of the wastes to the treatment facility. The remainder (40 percent) flows to the plant by gravity. The estimated population served by this installation is 85,000 people, and the average flow, based on 1963-64 monthly averages, is approximately 11.0 MGD.

## Treatment

Modified aeration and chlorination are employed. This aeration process is normally operated with a two hour detention time, based on a return sludge rate of 10%, and a final settling tank overflow rate of approximately 1,000 gallons per square foot per day. The process is operated satisfactorily without primary sedimentation; however, the final tanks are equipped for removal of the grease load which passes through the aerator.

Unit processes at the plant are screening, grit removal, aeration, final settling, thickening, digestion and chlorination. Digested sludge is disposed of at Marine Park, an area near the plant which is being developed into a recreational area by the Park Department. Treated effluent is discharged directly into Raritan Bay approximately 2,000 feet offshore. The plant bypass is designed to discharge to a drainage ditch which empties into Raritan Bay.

In January 1964 the treatment plant changed its disinfection arrangement so that 15% sodium hypochlorite would be used rather than liquid chlorine. This modification was reportedly made for reasons of safety. Based on plant records, hypochlorite consumption is 350 gpd. An automatic chlorine residual recorder has been installed; however, it is not connected to the bleach feed rate.

## Findings

### Performance Summary

| Date | Flow mgd | Sus-Solids | | BOD | | Coliform |
|---|---|---|---|---|---|---|
| | | Eff mg/l | % Rem | Eff mg/l | % Rem | % over 1.0/ml |
| 24 hour studies | | | | | | |
| 8-2,3-62 | 8.4 | 37 | 77 | 81 | 57 | 8 |
| 9-27,28-62 | 11.6 | 47 | 82 | - | - | 29 |
| 1-10,11-63 | 8.8 | - | - | 20 | 82 | 0 |
| 5-5,6-64 | 10.5 | 26 | 62 | - | - | 38 |
| Grab Samples | | | | | | |
| 8-7-62 - 9-10-63 (49 samples) | 10.9 | 23 | - | 17 | - | 29 |
| 9-28-64 - 12-27-65 (14 samples) | 8.2 | 106 | - | 41 | - | 43 |
| 12-28-65 - 5-20-66 (5 samples) | 6.7 | 45 | - | 31 | - | 40 |

Project personnel have conducted four 24-hour comprehensive studies and collected 68 grab samples of the effluent. Suspended solids removal during extended studies met the Compact requirements of 60 percent. During all sampling programs — 24 hour, grab — the coliform requirements were met.

The plant, as presently operated, more than adequately meets the minimum requirements for personnel, record keeping and laboratory control as recommended by the Conference of State Sanitary Engineers.

It would appear, based on preliminary investigations conducted by FWPCA, that infiltration into the sewer system is quite significant, possibly reaching as high as 3.0 MGD. Since chloride levels in the raw wastes do not fluctuate it would appear that infiltration is due possibly to fresh groundwater.

## WOODBRIDGE-SEWAREN

### Background

The Woodbridge-Sewaren treatment plant serves a 3.4 square mile area of Woodbridge Township, N.J. The 1960 population served was approximately 30,000 people. The facility, constructed in 1954 to accommodate a maximum design flow of 10.0 MGD, is presently handling 3.9 MGD. Flows exceeding 10 MGD are bypassed to the Arthur Kill.

A separate sanitary sewer system, which is known to have an infiltration problem, serves the area. Industrial connections to the system are few in number.

Effluent from this facility is discharged to the Arthur Kill in Class B waters, where the ISC requirement is 10% removal of suspended solids and no reduction of coliform organisms. At the request of ISC the Sewaren plant installed chlorination facilities in 1962.

### Treatment

Treatment facilities include two mechanically cleaned grit chambers; two bar screens, two aerated flocculation units; two sedimentation tanks; two sand filters; chlorine contact tank; and two vacuum filters.

The sand filters have been out of operation for several years and are not providing treatment.

### Findings

Performance Summary

| Date | Flow | Sus Solids | | BOD | | COD | | Coliform % over |
|---|---|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | Eff mg/l | %Rem | 1.0/ml |
| *5-25,26,65 | 3.9 | 83 | 51 | 134 | 35 | 346 | 28 | 4.0 |
| 6-24-65 | | 55 | 89 | 111 | 23 | | | 100 |
| 8-18-65 | 2.1 | 59 | 92 | 76 | 58 | | | 0 |
| 9-22-65 | 2.5 | 60 | 83 | 130 | -- | | | 100 |
| 10-26-65 | 1.5 | 83 | 5 | 123 | 15 | | | 100 |
| 11-30-65 | 2.3 | 89 | 75 | 124 | 30 | | | 0 |
| 12-28-65 | 2.7 | 77 | 59 | 59 | 69 | | | 0 |
| 1-18-66 | 2.6 | 158 | 16 | 134 | 18 | | | 0 |
| 2-16-66 | 2.8 | 30 | -- | 11 | 73 | | | 0 |
| 3-24-66 | 3.8 | 73 | 45 | 38 | 34 | | | 100 |
| 4-19-66 | 8.5 | 59 | 47 | 80 | 11 | | | 100 |
| 5-18-66 | 2.4 | 41 | -- | 56 | 3 | | | 100 |

*24 hour study (25 samples)

New Jersey State Health Department has issued orders against Sewaren to provide secondary treatment.

## CARTERET

### Background

The Carteret treatment plant, constructed in 1953 to handle an average flow of 3.0 MGD, serves the Borough of Carteret, N.J. Present tributary population is approximately 15,000 people.

A combined sewer system, covering an area of approximately 4.5 square miles, serves the plant. Storm water overflows are located at seven points in the system - six discharge to the Arthur Kill and one to the Rahway River. All regulators are reportedly controlled by float valves.

Effluent from this primary treatment facility is discharged to the Arthur Kill approximately 4,000 feet south of the mouth of the Rahway River. This section of the Kill is Class "B" water. In 1962, however, at the request of the ISC, chlorination facilities were provided.

### Treatment

Treatment consists of screening, grit removal, sedimentation and chlorination. Sludge is dewatered on vacuum filters and disposed of at a landfill site. Sand filters were initially constructed, however, they are presently out of operation.

### Findings

Performance Summary

| Date | Flow | Sus Solids | | BOD | | COD | | Coliform % |
|---|---|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| *5-27,28-65 | 2.5 | 80 | 68 | 134 | 41 | 384 | 24 | 56 |
| 6-24-65 | 2.4 | 68 | 79 | 84 | 38 | | | 100 |
| 8-18-65 | 2.7 | 76 | 65 | 102 | 39 | | | 100 |
| 9-22-65 | 2.5 | 96 | 45 | 100 | 40 | | | 100 |
| 10-26-65 | 2.6 | 94 | 66 | 130 | 45 | | | 100 |
| 11-30-65 | 3.0 | 89 | 57 | 76 | 53 | | | 0 |
| 12-28-65 | 3.4 | 153 | 5 | 86 | 53 | | | 0 |
| 1-18-66 | 2.5 | 109 | 72 | 69 | 61 | | | 0 |
| 2-16-66 | 3.5 | 64 | 86 | 18 | 69 | | | 0 |
| 3-24-66 | 2.6 | 134 | 62 | 82 | 63 | | | 100 |
| 4-19-66 | 2.3 | 41 | 45 | 31 | 62 | | | 0 |
| 5-18-66 | 2.7 | 43 | 37 | 12 | 86 | | | 0 |

*24 hour study (25 samples)

New Jersey State Health Department has issued orders against Carteret to provide secondary treatment. The facility as presently operated is not meeting the coliform requirements of the Compact. During a 24 hour study conducted by the Project only 11 out of 25 samples had a coliform count of less than one coliform per ml. Five of 11 grab samples, collected during an 11 month period, had greater than one coliform per ml.

# RAHWAY VALLEY SEWERAGE AUTHORITY

## Background

The Rahway Valley Sewerage Authority handles wastes from the communities of Springfield, Kenilworth, Cranford, Roselle Park, Westfield, Norwood, Clark, Woodbridge and Rahway, N.J. Approximately 70 industrial plants are tributary to the system, including Merck & Co., U.S. Gypsum, and White Pharmaceutical Co.

The Authority serves an area of 45 square miles which is limited by contract. The 1960 sewered population was estimated to be 180,000 people. There are reportedly no significant seasonal population changes.

This primary treatment facility, constructed in 1927, treats an average flow of 24 MGD, a minimum of 19 MGD, and a maximum of 31 MGD. The sewer system consists of both combined and separate sewers. There are six storm water overflows. Infiltration during storms is a problem, as flow increases 25 to 40% during these periods.

The outfall line, which is about three to four miles long, discharges into the Arthur Kill in Class "B" waters - about 2,500 feet south of the Rahway River outlet.

## Treatment

Treatment consists of screening, grit removal, pre-chlorination, sedimentation and digestion. Sludge - both primary and digested - is pumped to the Linden-Roselle plant for storage and consequent barging to sea.

See Performance Summary next page

**Findings**

**Performance Summary**

| Date | Flow | Sus Solids | | BOD | | COD | | Coliform % |
|---|---|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| *6-9,10-65 | 19.7 | 79 | 55 | 184 | 27 | 436 | 21 | No chlorination req. |
| 6-24-65 | 30.0 | 93 | 72 | 124 | 15 | | | " " " |
| 8-18-65 | 23.0 | 42 | 60 | 142 | 11 | | | " " " |
| 9-22-65 | 25.0 | 80 | 72 | 155 | 4 | | | " " " |
| 10-26-65 | 25.0 | 77 | 74 | 121 | 30 | | | " " " |
| 11-30-65 | 24.0 | 71 | 67 | 169 | 22 | | | " " " |
| 12-28-65 | 24.0 | 92 | 58 | 179 | 43 | | | " " " |
| 1-18-66 | 26.0 | 73 | 69 | 220 | -- | | | " " " |
| 2-16-66 | 30.0 | 53 | 52 | 144 | -- | | | " " " |
| 3-24-66 | 26.0 | 111 | 61 | 173 | 21 | | | " " " |
| 4-19-66 | 10.0 | 152 | -- | 232 | 31 | | | " " " |
| 5-18-66 | 18.5 | 56 | 81 | 237 | -- | | | " " " |

*24 hour study

New Jersey State Health Department has issued orders against the Authority to provide secondary treatment. Pilot facilities are presently being operated to determine method of treatment.

# LINDEN-ROSELLE

## Background

The Linden-Roselle plant handles wastes from the communities of Linden and Roselle, N.J. About one year prior to World War II, the Interstate Sanitation Commission ordered these cities to stop polluting the tidal waters of New Jersey. Due to the emergency of the war a number of extensions were granted to the two municipalities. After the war, it was decided to construct a plant as a joint project. This primary treatment facility, designed to handle an average flow of 12.5 MGD, was completed in 1952. It presently serves a population of approximately 120,000 people.

The cities are each served by separate sanitary sewer systems which reportedly have no infiltration problems. Each municipality has an ordinance requiring connection to the sewer. Approximately 20% of the population equivalent load to the plant results from industrial discharges.

The 1964 hydraulic load was as follows:

Minimum day............7 MGD
Average day...........10 MGD
Maximum day...........18 MGD

Effluent discharges to the Arthur Kill. Raw sewage by-passes are located on the Kill near the Esso Bayway Refinery and at Morses Creek.

## Treatment

Treatment consists of screening, grit removal and sedimentation. Raw sludge from this facility, as well as digested and primary sludge from the Rahway Valley plant, is stored in tanks prior to barging to sea.

See Performance Summary on next page

## Findings

### Performance Summary

| Date | Flow | Sus Solids | | BOD | | COD | | Coliform % over |
|---|---|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | Eff mg/l | %Rem | 1.0/ml |
| *6-14,15-65 | 7.9 | 109 | 68 | 334 | 37 | 625 | - | No chlorination req. |
| 6-24-65 | 12.0 | 156 | 58 | 350 | -- | | | " " " |
| 8-18-65 | 12.0 | 71 | 56 | 541 | -- | | | " " " |
| 9-22-65 | 11.0 | 155 | 48 | 602 | -- | | | " " " |
| 10-26-65 | 11.0 | 58 | 82 | 299 | 49 | | | " " " |
| 11-30-65 | 11.0 | 136 | 51 | 850 | -- | | | " " " |
| 12-28-65 | 8.0 | 70 | 39 | 352 | 6 | | | " " " |
| 1-18-66 | 11.0 | 77 | 73 | 322 | 25 | | | " " " |
| 2-16-66 | 15.0 | 171 | 50 | 534 | -- | | | " " " |
| 3-24-66 | 10.0 | 192 | -- | 359 | 49 | | | " " " |
| 4-19-66 | 10.0 | 156 | 43 | 613 | 5 | | | " " " |
| 5-18-66 | 10.5 | 107 | -- | 488 | 22 | | | " " " |

*24 hour study

New Jersey State Health Department has issued orders against Linden-Roselle to provide secondary treatment. Plant presently operating pilot facilities to determine system for handling their wastes.

# JOINT MEETING

## Background

The Joint Meeting Plant provides primary treatment for wastes from the communities of East Orange, Hillside, Irvington, Maplewood, Newark, Millburn, Roselle Park, South Orange, Summit, Union, West Orange, and Elizabeth, N. J. The facility, constructed during the period 1931-37, had a 1950 connected population of 475,000 people.

The hydraulic loading during 1964 was as follows:

| | |
|---|---|
| Minimum day............ | 38.0 MGD |
| Average day............ | 53.5 MGD |
| Maximum day............ | 114.0 MGD |
| Peak hour.............. | 178.0 MGD |

All of the communities with the exception of Elizabeth, which has a combined system, have separate sewers. Storm waters from Elizabeth discharge to the Arthur Kill. Infiltration, which is a problem in some locations, is the responsibility of the individual areas.

All participants have ordinances that require connection to the sewer system. Connection of industrial facilities to the sewers is the responsibility of the particular municipality. It is estimated that half of the present flow is of industrial origin.

## Treatment

Treatment consists of screening--coarse and fine; grit removal in four mechanically cleaned units; and sedimentation in four rectangular tanks equipped with mechanical sludge and scum collectors. Sludge from the settling units is pumped to two 70 foot diameter by 28.5 foot deep storage units. Disposal of sludge--25 trips per year--is by barging.

Effluent from this facility, which is presently not chlorinated, is discharged to the Arthur Kill at the foot of Clifton Street in Elizabeth. The treatment facilities cannot be bypassed.

## Findings

### Performance Summary

| Date | Flow | Sus Solids | | BOD | | COD | | Coliform % over |
|---|---|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | Eff mg/l | %Rem | 1.0/ml |
| *6-16,17-65 | 47.4 | 78 | 64 | 191 | 23 | 356 | 34.2 | No chlorination req. |
| 6-24-65 | 63.0 | 92 | 60 | 104 | 53 | | | " " " |
| 8-18-65 | 66.0 | 92 | 16 | 173 | 39 | | | " " " |
| 9-22-65 | 60.0 | 217 | — | 249 | -- | | | " " " |
| 10-26-65 | 26.0 | 127 | 2 | 93 | 28 | | | " " " |
| 11-30-65 | 25.0 | 46 | 60 | 115 | 7 | | | " " " |
| 12-28-65 | - | 51 | 40 | 137 | 0 | | | " " " |
| 1-18-66 | 29.0 | 48 | 69 | 124 | 12 | | | " " " |
| 2-16-66 | 81.0 | 154 | 26 | 158 | 17 | | | " " " |
| 3-24-66 | 38.0 | 58 | 46 | 81 | 2 | | | " " " |
| 4-19-66 | 55.0 | 121 | 31 | 244 | 38 | | | " " " |
| 5-18-66 | 65.0 | 91 | 65 | 108 | 50 | | | " " " |

*24 hour study

New Jersey State Health Department has issued orders against Joint Meeting to provide secondary treatment. Plant is presently operating pilot facilities to determine the most efficient treatment system.

# KEASBY

## Background

The Keasby wastewater treatment plant, constructed in 1940, serves a small portion of Woodbridge, N.J. The facility handles municipal sewage, from a tributary population of approximately 3,000 people, and wastes from several petro-chemical industries. Designed to treat 1.25 MGD, the plant will automatically bypass flows in excess of this amount.

The sewer system, constructed in 1900, reportedly has no serious infiltration problems.

## Treatment

Keasby was originally designed as an intermediate-type treatment plant utilizing magnetite filters. Present operation is primary — filters inoperative; also filters not recognized by the State as a treatment method.

Treatment at Keasby includes screening, grit removal, sedimentation, chlorination and digestion. Sludge is dewatered on glass covered sand beds.

## Findings

During visitations by Project personnel it was learned that approximately 200 lbs/day of lime are being added to the raw sewage between the hours of 7 a.m. and noon. Whether or not the addition of this chemical improves treatment is questionable since no data were available.

### Performance Summary

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| 24 hour studies<br>5-14,15-64 | 0.8 | 62 | 58 | 73 | 30 | 0 |
| Grab samples<br>10-6-64 to 12-28-65<br>(14 samples) | 0.9 | 82 | -- | 90 | -- | 7 |
| 1-18-66 to 5-18-66<br>(5 samples) | 1.0 | 77 | | 57 | | 20 |

During the 24 hour study conducted in May 1964, solids removal was only 58%. Bacteriologically, all 24 samples during this study had a coliform count of less than 1.0/ml. Of the 19 grab samples obtained between October 1964 and May 1966, two had a count of greater than 1.0 coliforms per ml.

The plant, as presently operated, meets the minimum standards as set by the Conference of State Sanitary Engineers, for laboratory control, record keeping and personnel.

## SAYREVILLE-MELROSE

### Background

The Melrose wastewater treatment plant, serving the Melrose section of Sayreville, N.J. was constructed in 1949 to accommodate a design flow of 0.1 MGD. Present population served is approximately 1,000 people, with an average flow of 0.05 MGD.

### Treatment

Treatment includes screening, sedimentation, chlorination and digestion. Sludge is dewatered in glass covered drying beds. Effluent discharges to the Raritan River, upstream of the Garden State Parkway Bridge.

### Findings

#### Performance Summary

| Date | Flow | Sus Solids | | BOD | | Coliform % |
|---|---|---|---|---|---|---|
| | mgd | Eff mg/l | %Rem | Eff mg/l | %Rem | over 1.0/ml |
| 10-16-61 | .046 | - | - | - | - | 0 |
| 3-5-62 | .013 | 40 | 61 | 88 | 36 | 0 |
| 4-3-62 | .015 | 40 | 59 | 93 | 40 | 0 |
| 5-9-62 | .031 | 40 | 77 | 121 | 42 | 0 |
| 7-2-62 | .036 | 79 | 63 | 184 | 35 | 0 |
| 8-21-62 | .029 | 58 | 63 | 125 | 30 | 0 |
| 10-8-62 | .034 | 62 | 40 | 130 | 8 | 0 |
| 11-29-62 | .031 | 51 | 18 | 94 | neg | 0 |
| 2-6-63 | .024 | 50 | 40 | 140 | 3 | 0 |
| 3-18-63 | .031 | 36 | 38 | 101 | 17 | 0 |
| 3-16-64 | .032 | 49 | 80 | 215 | 52 | 25 |
| 5-5-64 | .025 | 36 | 63 | 154 | 41 | 0 |
| 6-17-64 | .014 | 57 | 65 | 69 | 63 | 0 |
| 11-3-64 | .030 | 72 | 58 | 162 | 31 | 0 |
| 2-16-65 | .031 | 36 | 62 | 102 | 40 | 75 |
| 4-21-65 | .040 | 101 | 34 | 157 | 22 | 0 |
| 8-9-65 | - | 61 | 48 | 118 | 38 | 0 |
| 11-3-65 | .030 | 72 | 58 | 162 | 31 | 0 |
| 2-17-66 | .040 | 40 | 61 | 98 | 45 | 0 |
| 5-4-66 | 0.06 | 27 | 69 | 107 | 21 | 0 |

Inspections by the Interstate Sanitation Commission since October 1961 have shown that the plant failed to meet the Compact requirements for suspended solids removal on nine out of the 20 occasions. Bacteriologically, the facility failed to meet the coliform requirements only once.

## RARITAN DEPOT

### Background

Constructed originally in 1917, this secondary treatment plant was expanded in 1944 by the U.S. Army Engineers. In 1964, with the closing of the Raritan Arsenal, the plant, along with a large portion of Arsenal property, was turned over to Middlesex County, N.J., which now operates the plant.

A separate sewer system, constructed in 1917, serves the area. All flow is by gravity, and reportedly infiltration is a problem.

### Treatment

Treatment includes screening, sedimentation, biological treatment — fixed nozzle trickling filters, chlorination and digestion. Sludge is dewatered on open drying beds. Effluent from the plant discharges to a small creek which is tributary to the Raritan River.

### Findings

| Date | Flow mgd | Sus Solids Eff mg/l | Sus Solids %Rem | BOD Eff mg/l | BOD %Rem | Coliform % over 1.0/ml |
|---|---|---|---|---|---|---|
| 10-6-64 to 12-28-65 (13 samples) | 0.05E | 17 | 45 | 10 | 63 | 0 |
| 1-18-66 to 5-18-66 (5 samples) | 0.06E | 9 | 70 | 2 | 94 | 20 |

Eighteen grab samples were collected by the Project during the period October 1964 to May 1966. Only one out of 18 had a coliform count of greater than 1.0 per ml.

The plant, as presently operated, is underloaded. During 1961, when the Arsenal was in operation, flow averaged 250,000 to 300,000 gpd. Due to the present low flow the trickling filters are not biologically active. Low BOD and solids in the effluent is attributed to dilution with infiltration and air conditioning cooling waters. The present day-time population served is estimated at 300 people; during the evening hours this decreases to approximately 10 people.

Conditions at the plant most likely will change as the county opened a junior college in September 1966 on the old arsenal property. Ultimate student population is estimated to be 800 people.

# SOURCES OF POLLUTION

STORMWATER OVERFLOWS

NAVIGATION & RECREATIONAL BOATING

INDUSTRIAL WASTES

61a

## STORMWATER OVERFLOWS

The major combined sewer system with stormwater overflows discharging directly to Raritan Bay is Perth Amboy, N.J. This combined sewer system has a total of 19 overflow outlets. During the summer of 1961 the New Jersey State Department of Health conducted an extensive study which indicated that significant overflow begins when the registered plant flow rate is between 10 and 10.5 MGD. No diversion occurred in any of the chambers when the plant influent rate was 8.5 MGD or less.

An analysis of plant influent pumping charts for the period August 1960 to July 1961 indicated that the influent flow at the plant was less than 8.5 MGD 90.2% of the time. The influent flow rate was between 10.0 and 10.5 MGD only 0.3% of the time. Flows greater than 10.5 MGD occurred for 12 hours during the year, or about 0.1% of the time.

To estimate the order of magnitude of loadings upon Raritan Bay from the overflow of the Perth Amboy system, a storm was assumed which results in a total rainfall of one inch over a 24-hour period. Weather Bureau records at New Brunswick and Rahway, N.J., indicated that storms with a daily rainfall of one inch or greater occurred 23 times during the 31 month period May 1962 through November 1964, or nine percent of the time. More than half of these storms occurred during the summer months, May through September.

The Perth Amboy sewer system serves an area of 1.50 square miles. Assuming complete runoff and a normal dry-weather sewage flow of 6.2 MGD, the assumed storm would result in a total discharge of 32 MGD. With diversion of all flows over 10 MGD, 22 MGD of combined sewage and stormwater could be discharged to the Bay. With complete mixing, and no added BOD loading from stormwater runoff, the BOD load diverted would be approximately 7,000 lbs/day. While it is true that with the observed frequency of such storms the total BOD load, on a yearly basis, would amount to only 170 lbs/day — 25% of the normal load imposed by the Perth Amboy plant discharge — such loads are imposed over a short period of time and do constitute a problem. Equally significant is the bacteriological degradation which results from the discharge of unchlorinated raw municipal sewage during the bathing season. Such contamination represents a hazard to those persons using these waters for recreational activities following summer storms.

Combined sewers serving the Tottenvile area of Staten Island, N.Y., also discharge overflows into Raritan Bay. Similar systems serving easterly Staten Island and the Red Hook section of Brooklyn, N.Y., discharge overflows to Upper Bay in the immediate vicinity of the Narrows. Since sewage from this same area is discharged without treatment the effects of such overflows are not significantly different from those resulting from the normal discharge of raw sewage. However, once adequate treatment and disinfection have been provided to normal sewage from this area, the overflow of combined sewage will still present a bacteriological hazard to users of these waters in the same manner as described for Perth Amboy.

Hence, at present, the effects of stormwater discharges on water quality in Raritan Bay are masked by the large volume of raw sewage discharges. Separation of these two effects is not possible with present technology.

# POLLUTION FROM NAVIGATION AND RECREATIONAL BOATING

Raritan Bay is widely used for both commercial navigation and recreational boating. Both of these uses result in pollution of the study area waters. The Project reviewed existing information on commercial navigation and conducted a survey of recreational boating to determine the magnitudes of loads from these respective sources.

The major problem of fecal pollution from commercial vessels was found to be concentrated in the berthing areas where the equivalent population was estimated at 600 persons. Pollution from vessels in anchorage or in transit was found to be equal to a population of less than 100 persons. These figures do not include pollutional loads which occur as a result of discharge of oil and other bilge wastes, discard of garbage, trash and other debris, and spillages at dockside during cargo transfer.

The pollution loads associated with recreational boating occur as a result of discharge of human wastes, contamination from fuel and oil by spillage and engine exhausts, discard of trash and garbage, and use of chumming bait when boats are involved with fishing activities. It was estimated that the pollution load to Raritan Bay from recreational boating is presently 725 lbs/day of BOD. The fecal bacterial loading was estimated as that associated with the raw discharge from nearly 6,000 persons. The source of pollution from recreational boating is spread uniformly over Raritan Bay rather than being located at a particular point, as would be the case for the discharge from a municipal treatment plant. The magnitude of this pollution load, however, is sufficient to warrant further study and the development of adequate treatment facilities to insure control of pollution from these sources.

# INDUSTRIAL WASTES

## General

Sources and characteristics of industrial wastes discharged to Raritan Bay, Arthur Kill and Raritan River are described in this section. Table V summarizes the total wastes flow with a breakdown by major industry type. Table VI presents specific information on the various industries throughout the study area. These data have been compiled from a number of sources. All of the industries listed were visited by the Project, and in a number of cases sampling and analyses of the wastes effluents were performed. Much of the data presented were provided by the industries as a result of their wastes monitoring programs, or calculations of a material balance. Information was obtained also from the Interstate Sanitation Commission, New Jersey State Department of Health, and New York City Department of Health.

Raritan Bay receives the direct discharge from two industries. Wastes from International Flavors & Fragrances Inc., which amounts to 2,500 lbs/day of BOD, is discharged on an intermittent basis. The S.S. White Co., discharges approximately 0.5 MGD of treated wastes.

Arthur Kill receives the wastes discharge from 21 industries and three power generating stations. The 21 industries discharge a total of 320 MGD, imposing a loading of more than 100,000 lbs/day of BOD and 187,000 lbs/day of COD upon the Kill. In addition to these oxygen demanding wastes the Kill receives 10 tons per day of oil and 4.0 tons per day of phenol from the sources shown in Table VI. The three power generating stations, which use 1,660 MGD of Kill water for cooling purposes, pollute the waters with an estimated 200 billion BTU's per day of heat. The total industrial wastes flow to the Arthur Kill from both process industries and power generating stations amounts to nearly 2,000 MGD.

As of January 1, 1967, 10 industries discharged to the Raritan River and two power plants utilized it as a source of cooling water. Of the 10 industries, one — Hatco Chemical, Division, W.R. Grace & Co., — is scheduled for connection to the Middlesex County Sewerage Authority trunk sewer early in 1967. Seven of the remaining industries participate at least partially in the same trunk sewer system. However, a number of these industries return contaminated cooling waters to the Raritan River, thus imposing a pollutional load. The plants on the waterway, exclusive of power stations, discharge 85 MGD of wastes with a BOD loading of 70,000 lbs/day. The power stations utilize 400 MGD of cooling water, resulting in thermal pollution of 33 billion BTU's per day of heat.

## Sources

Industries listed in Table VI were visited by Project personnel during the period April 1965 thru February 1966. During these meetings with company officials plant operations — processes, capacity, water consumption, waste discharges, raw materials — were reviewed. Summary reports of each visit are included in this section.

## TABLE V

## INDUSTRIAL WASTE SUMMARY

| Industry Type | No. of Sources | Flow MGD | Loadings in lbs per day |  |  |  |  |  | Pop. Equiv. (BOD) | Other Pollutants |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | BOD | COD | Phenol | Oil | P | Total N |  |  |
| **ARTHUR KILL** |  |  |  |  |  |  |  |  |  |  |
| Petroleum | 4 | 279.3 | 51,930 | 128,100 | 6,780 | 16,325 | 350 | 5,175 |  |  |
| Chemical | 9 | 38.4 | 40,370 | 58,290 | 3,990 | 3,240 | 3,000 |  |  |  |
| Metal | 4 | 43.7 | -- | -- | -- | Ins |  |  |  | Trace Metals and Oil |
| Power Generation | 3 | 1,659.0 | -- | -- | -- | -- | -- | -- |  | $20 \times 10^{10}$ BTU Heat |
| Miscellaneous | 4 | 5.9 | 12,340 | 1,280 |  | 280 |  |  |  |  |
| Total, Arthur Kill | 24 | 2,026.3<br>(367.3) | 104,640 | 187,670 | 10,770 | 19,845 | 3,350 | 5,175 | 615,000 |  |
| **RARITAN BAY** |  |  |  |  |  |  |  |  |  |  |
| Power Generation | 1 | 100.0 |  |  |  |  |  |  |  | $0.8 \times 10^{10}$ BTU Heat |
| Miscellaneous | 2 | 0.1 | 2,500 |  |  |  |  |  |  |  |
| Total, Raritan Bay | 3 | 100.1<br>(0.1) | 2,500 |  |  |  |  |  | 14,700 |  |
| **RARITAN RIVER** |  |  |  |  |  |  |  |  |  |  |
| Chemical | 8 | 71.9 | 67,825 | 45,250 | Ins |  |  |  |  |  |
| Power Generation | 1 | 300.0 |  |  |  |  |  |  |  | $2.5 \times 10^{10}$ BTU Heat |
| Miscellaneous | 2 | 13.8 | 2,275 |  |  |  |  |  |  |  |
| Total, Raritan River | 11 | 385.7<br>(85.7) | 70,100 | 45,250 |  |  |  |  | 421,000 |  |

# TABLE VI - INDUSTRIAL WASTE DISCHARGES

| Name | Flow MGD | Loadings (lbs/day) | | | | | | | Receiving Water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | BOD | COD | Phenol | Oil | P | $NH_3$-N | Total N | | |
| **PETROLEUM INDUSTRY** | | | | | | | | | | |
| Humble | 212.7 | 46,920 | 102,600 | 6,640 | 15,000 | 320 | 2,800 | 3,200 | Arthur Kill | 1 |
| Chevron | 56.0 | 2,150 | 13,100 | 40 | none | 10 | 520* | 1,275 | " " | 1*includes 635 lbs/day $NO_2$ N |
| Hess | 1.6 | 990 | 4,000 | 90 | 300 | 10 | 640 | 660 | " " | 1 |
| Citgo | 9.0 | 1,870 | 8,400 | 10 | 1,025 | 10 | 40 | 40 | " " | 1 |
| **CHEMICAL INDUSTRY** | | | | | | | | | | |
| American Agricultural | - | - | - | - | - | 500 | | | Arthur Kill | 2 Estimated P |
| DuPont - Grasselli | . | - | - | 2,500 (See specific report) | | | | | Arthur Kill | 2 Material Bal. |
| FMC | 5.6 | 40 | - | - | - | 2,000 | | | Arthur Kill | 2,3 |
| Reichhold Chem.,Carteret | 0.2 | Neg. | Neg. | Neg. | | | | | Arthur Kill | 2,3 |
| American Cyanamid,Linden | 6.4 | 7,970 | - | - | - | - | | | Arthur Kill | 2,3 |
| " " Woodbridge | 0.1 | Neg. | - | - | - | - | | | Arthur Kill | 2,3 |
| General Aniline | 26.0 | 31,800 | 57,500 | 1,490 | 3,240 | - | | | Arthur Kill | 2,3 |
| Armour Agricultural | - | - | - | - | - | 500 | | | Arthur Kill | 2,3 |
| Sinclair-Koppers | 0.1 | 560 | 790 | - | - | - | | | Arthur Kill | 2,3 |
| Union Carbide | 0.6 | 235 | 1,700 | 20 | - | - | | | Raritan River | 2,3,4 |
| National Lead | 43.0 | - | - | - | - | -$H_2SO_4$ 5000#<br>$FeSO_4$ 3000# | | | Raritan River | 2,3,4 |
| Amer.Cyanamid B.Brook | 22.5 | *3,600 to 28,000 | - | - | - | - | | | Raritan Rivur | 2,3<br>*seasonal variation |
| Hatco | 1.3 | 36,830 | 42,350 | - | - | - | | | Raritan River | 2,3,4 |
| Tenneco | 1.2 | 600 | 1,200 | - | - | - | | | Raritan River | 2,3,4 |
| DuPont-Photo Products | - | 1,000 | - | - | - | - | | | Raritan River | 2,3,4 |
| DuPont-Finishing | - | 360 | - | - | - | - | | | Raritan River | 2,3,4 |
| Hercules Powder | 3.3 | 800 | - | - | - | - | | | Raritan River | 2,3,4 |

## METALS INDUSTRY

| Name | Flow MGD | Loadings (lbs/day) Cu | Pb | Oil | Ni | Receiving Water | Remarks |
|---|---|---|---|---|---|---|---|
| Amer. Smelting & Ref. | 7.7 | 55 | nil | | | Arthur Kill | 1,2,5 |
| U.S. Metals | 35.8 | 165 | nil | | 200 | Arthur Kill | 1,2,5 |
| Phelps Dodge | .07 | 30 | | 20 | | Arthur Kill | 2,5 |
| Nassau Smelting | 0.10 | 75 | 60 | | | Arthur Kill | 1,5 |

## POWER GENERATION INDUSTRY

| Name | Flow MGD | Temp. Increase of | BTU per day | Receiving Water | Remarks |
|---|---|---|---|---|---|
| Public Service, Sewaren | 910 | 15 | $11.4 \times 10^{10}$ | Arthur Kill | 2 |
| Public Service, Linden | 345 | 15 | $4.3 \times 10^{10}$ | Arthur Kill | 2 |
| Consolidated Edison | 404 | 13 | $4.4 \times 10^{10}$ | Arthur Kill | 2 |
| South Amboy Power & Light | 100 | 10 | $0.8 \times 10^{10}$ | Raritan Bay | 2 |
| Jersey Central, Sayreville | 300 | 10 | $2.5 \times 10^{10}$ | Raritan River | 2 |

## MISCELLANEOUS INDUSTRIES

| Name | Flow MGD | BOD | COD | Chrome or Cr | CN | ABS | Suspended Solids | Oil | Receiving Water | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| International Flavors & Fragrances | 0.04 | 2,500 | | | | | | | Raritan Bay | Intermittent<br>2 |
| S.S. White | 0.05 | - | - | 2 | 0.33 | | | | Raritan Bay | 2,3 |
| Procter & Gamble | 5.4 | 12,000 | | | | 240 | 4,600 | | Arthur Kill | 2,3 |
| General Amer. Transp. | .01 | | Trace loadings only | | | | | | Arthur Kill | 2 |
| Archer Daniels Midland | .44 | 200 | 1030 | - | - | - | - | 240 | Arthur Kill | Negl. phenol ISC & NJ<br>2,3 |
| Koppers Wood Preserving | .005 | 140 | 250 | - | - | - | - | 40* | Arthur Kill | *6#/day phenol<br>2,3 |
| Johns-Manville | 13.3 | 2,100 | - | - | - | - | 2,100 | - | Raritan River | 2,3 |
| Philip Carey | 0.50 | 175 | | | | | 45 | | Raritan River | 2,3 |

## TABLE VI - INDUSTRIAL WASTE DISCHARGES

### RAMARKS KEY

1. Based on sampling by Project.
2. Company supplied data.
3. Data supplied by either State Health Department, ISC or MCSA.
4. Cooling water discharged; MCSA participant.
5. Cooling water discharge.

## Humble Oil & Refining Co., Bayway Refinery

## Linden, N.J.

### 1. Organization:

The Bayway Refinery is located at the eastern edge of Linden, N.J. between U.S. Highway 1 and the Arthur Kill. The refinery property consists of some 1,400 acres which includes tank farm areas. The modernization program and consolidation of equipment has left considerable open space in the process areas.

This refinery dates back to 1908. It was originally operated as Standard Oil of New Jersey. Through the years the Bayway Refinery has been outstanding in the petroleum refining industry.

The Clean Water and Air Effluent improvement activity at Bayway is carried out by ten men who devote most of their time to waste control. This unit includes one full-time Laboratory Technician. Dr. W.H. Lang, Staff Consultant, Esso Research and Engineering Company, Florham Park, N.J., represents the Bayway Refinery on the A.P.I. Wastes Disposal Committee. Through Dr. Lang, the Bayway Refinery personnel engaged in waste control are kept informed on new developments in the petroleum industry pertaining to liquid wastes control and treatment.

### 2 Products:

Humble Oil and Refining Company presently markets some 2,000 different petroleum products. The trend at Bayway Refinery is toward diversification, but most of the products continue to be large volume production. Production is geared to continuous flow rather than batch operations.

The principal products run at this refinery are:

- Fuel Gas
- Ethylene
- Isobutylene
- S.B.O.H.
- M.E.K.
- Acetone
- MIBK-MIBC
- Isophorone
- Paratone & Vistanex
- L.P.G.
- Polymer Chemicals
- MO Gas
- Jet
- Diesel
- Heating Oil
- Clarified Oil
- Fuel Oil
- Asphalt
- Lube Additives
- Turbo Oil
- White Oil & Trans. Oil
- Sulphonates

3. Raw Materials:

Crude oil is received by tankers from the Gulf of Mexico and South America. These crudes vary considerably but would be classified either mixed base or asphalt base. These are essentially sweet crudes, the sulfur concentration seldom exceeding 2.5%. Salt concentration in the crude runs about five pounds per a thousand barrels of crude.

Raw materials vary with the end products and the treatment processes employed. This is particularly true in the Chemical Products Department. The refinery proper will normally use significant quantities of: sulfuric acid, caustic, lime, soda ash, ammonia, catalysts, diethanolamine, and others.

4. Capacity:

This refinery has a capacity for refining 172,000 barrels (42 gallon barrel) of crude oil per day. Crude intake does not completely reflect effluent characteristics because of the practice of processing intermediate products received from affiliate refineries. Design of much of this process equipment permits flexibility in operation.

5. Operations:

The pipe stills, catalytic cracking unit and auxiliary equipment operate continuously. The pipe stills are distinctly segregated from catalytic cracking with considerable intermediate storage for gas oil. A large number of tanks are utilized to minimize the effect of demand for seasonal products. Many of the secondary treatment processes are continuous. Although there are certain batch-type treatment processes with intermittent discharge, refinery operations are essentially on a 24-hour day, seven-day week basis.

6. Water Supply:

Three sources of water are available, namely, Arthur Kill, surface reservoirs, and Elizabethtown public water supply. The Elizabethtown water is used for drinking and sanitary purposes.

The bulk of water for the refinery is pumped from the Arthur Kill and is used for cooling purposes. The relative quantity of salt water to fresh water was not known, but Arthur Kill water was believed to represent approximately 99% of the total water used. The only treatment given Arthur Kill water is "slug chlorination", once each shift, winter and summer.

West Brook and Peach Orchard Creek are the source of run-off water. Within the refinery, these streams are impounded into a series of reservoirs upstream from No. 2 Dam. Some of this reservoir water is pumped to Public Service Electric and Gas Company in exchange for steam furnished the Bayway Refinery, and some is pumped to Esso's water treating unit and to other limited use within the refinery.

## 7. Sewerage:

There are four entirely separate sewer systems within the refinery. These are:

a. Sanitary wastes to Linden-Roselle.

b. Oil water sewers.

c. Cooling and condenser water sewers.

d. Tank field sewer system.

The total refinery effluent averages 187 million gallons per day. Peak water pumpage occurs during the latter part of August when total process water use and cooling may reach 220 million gallons per day. These volumes are exclusive of sanitary wastes.

The refinery effluent is the discharge over No. 1 Dam which is located in the lower reaches of Morses Creek. This stream discharges to the Arthur Kill at the northeast corner of refinery property and approximately 2,200 feet north of the refinery intake.

## 8. Principal Processes:

The principal processes of the Bayway Refinery, exclusive of the Chemical Products Department, are:

Atmospheric Distillation
Vacuum Distillation
Visbreaking
Catalytic Cracking
Reforming
Polymerization
Alkylation
Superfractionation
Gas Oil Hydrofining
General Treating
Hvy. Cat. Naph. Hydrofining

## WASTES CHARACTERISTICS

The amount of non-hydrocarbon constituents in the petroleum may be taken as a fairly good criterion of the extent of treatment required to produce marketable products. The principal impurities in petroleum include: free sulfur, hydrogen sulfide, sulfur compounds, nitrogen, and oxygen. The asphaltic and resinous bodies which are present in various amounts in most crude are considered to be formed, in part, by the oxidation and polymerization of certain hydrocarbons in the crude oil. Process wastes from a petroleum refinery may be expected to contain various chemicals used in treatment of petroleum products, combined with the impurities referred to, together with oil in various stages of process. Many of these wastes are relatively small but their effects on the refinery effluent are accumulative.

The most offensive constituents in petroleum refinery wastes, from the standpoint of pollution, are believed to be phenols, mercaptans, nitrogen bases, naphthenic acids, and oil. With the exception of oil, these most offensive substances are normally concentrated in the wastes resulting from chemical treatment. The overhead receiver water from catalytic cracking units is a significant source of phenol.

Light distillate oils may contain $H_2S$, low molecular weight naphthenic acids, phenol compounds, mercaptans, and other sulfur compounds. Organic nitrogen compounds may be present in low concentrations. Heavy naphtha and heating oils are now treated by the hydrofining process. Hydrofining has replaced all acid treating, doctor sweetening, and lead sulfide-sulfur sweetening.

Emulsions formed in refining operations are predominantly oil-in-water emulsions or systems of oil dispersed in water, the water constituting the external or continuous phase. The barometric condensers on the two vacuum pipe stills have been replaced by surface condensers therefy eliminating two major emulsion sources.

## WASTES TREATMENT PRACTICE

Humble Oil and Refining Company has taken cognizance of the value of oil wasted through the sewers and the damage resulting from oil pollution. Effort has been made in recent years to minimize wasting of oil to the sewers. Design of oil refinery equipment has made possible retrieving valuable oil as near the source as possible. Prevention of the comingling of various process wastes, containing oil, aids materially in reducing the tendency for troublesome emulsions to form.

### 9. Oil-Water Separators:

The Bayway Refinery has two master oil-water separators, each serving different plant areas. In addition there are three intermittent flow-type separators serving the outlying tank field areas south of Morses Creek. One fixed baffle has been installed at the No. 1 Dam on Morses Creek to skim oil carried over in the separator effluents or inadvertently discharged to the condenser water sewer system.

The east oil-water separator is 300 feet long by 100 feet wide with an eight foot water depth. This separator is divided into two channels, each with six compartments 50 feet square. Currently only half of this separator is in service at one time. The present flow was reported to be 9.9 MGD which gives a detention time of two hours and six minutes and an average velocity of 2.3 feet per minute. The east separator serves the area in which it is located, the principal sources including:

Atmospheric pipe stills.
Esso Research and Engineering Company.
Mechanical Shops area.
White Oil Division.
Office buildings and laboratories of Bayway.

The west oil-water separator was placed in operation in 1940. It consists of a pre-separation flume 125 feet long and three settling channels each twenty feet wide by 138.5 feet long with a 8.25 foot water depth. One of these channels was out of service because of a damaged flight scraper. The west separator presently receives 7 MGD flow. Considering three channels in service, the 7 MGD flow gives a detention time of one hour and 57 minutes (including the pre-separator flume) and a velocity of flow of 1.4 feet per minute.

The pre-separator flume in the west separator is quite effective, removing up to 80% of the oil entering this unit. Oil skimmers in each separator are operated manually. Recovered oil is pumped to slop oil tanks for decantation and heat treatment. Records indicate water-free recovered oil varying between 400 and 600 barrels per day.

## 10. Spent Chemicals:

Concerted effort is made to keep spent chemicals out of the sewers and it was reported that spent cresylics were sold and that shipments amounted to 100,000 gallons per month. Other spent caustics are shipped far out to sea in transocean tankers. Spent acids are sold to a local chemical firm. $H_2S$ gas is converted to sulfur by the same chemical company.

## 11. Analytical Results:

A Honeywell Effluent Monitor is located at the No. 1 Dam. This monitor continuously records dissolved oxygen, conductivity, temperature, and pH.

Samples for oil determination are routinely collected from the effluent at No. 1 Dam by refinery personnel. Oil results vary significantly from season to season. In general, effluent oil results obtained by the Bayway Refinery laboratory are higher than those reported by the control agencies. There appears to be a threefold variation in concentration of oil reported by the refinery laboratory. Considering a net concentration of 17 parts per million oil and a flow of 191 MGD, oil losses amount to 3,400 gallons per day (1957 refinery data).

Net phenol concentrations in the refinery effluent at No. 1 Dam likewise vary appreciably. Data from a 1962 Survey indicated that a net concentration of phenol in the effluent was 2.5 parts per million, giving a daily phenol loss of 4,000 pounds.

Considering that the effluents from the two oil-water separators are diluted ten to one with condenser water, it appears that oil concentrations in the A.P.I. separators may be as high as 170 ppm.

## WATER POLLUTION ABATEMENT PROGRAM

Attention was invited to the fact that salt water used at the Bayway Refinery complicated both analytical procedures and pollution abatement measures. It was estimated that over 95% of the flow through the oil-water separators originated in the Arthur Kill.

It was pointed out that from the design standpoint, the salt water cooling system was fully loaded during the peak summer periods. Accordingly, recent major increments of new cooling capacity have been provided as air fin installations. Substitution of the air fin installations avoids high capital cost of expanding the salt water pumping and distribution facilities.

The wastes control and water pollution abatement program at the Bayway Refinery is proceeding simultaneously along three lines. These are:

a. Progressive reduction in liquid volume.

b. In-plant improvements which reduce wastes.

c. Study of possible methods for treating residual wastes.

Decision as to treatment for residual wastes are dependent upon established water uses in the Arthur Kill and necessary protection of the bays into which the Kill discharges.

## The Cities Service Oil Company Linden Refinery

## Linden, N.J.

### 1. Organization:

The Cities Service Refinery is located at the eastern edge of Linden, N.J. between the New Jersey Turnpike and the Arthur Kill. The refinery property consists of some 240 acres, including a tank farm area located along the westerly portion of the New Jersey Turnpike in Linden. The installation, employing 150 people, was constructed in 1917 and completely rebuilt in 1958.

Mr. Joseph S. Baum, located in East Chicago, Indiana, is Waste Disposal Coordinator for the refinery. Mr. Robert G. Hand, Resident Chemist, along with two other chemists, are in full time attendance at the refinery.

### 2. Products:

The Cities Service Oil Company Refinery at Linden is essentially an asphalt plant. Production is geared to continuous flow rather than batch operations. The principal products run at this plant are:

Asphalt - 70% of the crude

300 end point gasoline

400 end point mineral spirits or Stoddard solvents

No. 2 fuel oil

Light and heavy virgin gas oil -- sold as cracker feed stock.

### 3. Raw Materials:

Crude oil is received by tankers from Mexico and Venezuela. Panoco crude is obtained from the Gulf and Tia Juana crude is received from South America. The Gulf crude, because of quality, will soon be phased out at this plant. It is anticipated that only Venezuela crude will be handled in the future. These are essentially sour crudes, the sulfur concentration generally being in the range of 5.0 to 5.25% (total sulfur by weight). Salt concentration in the crude runs from 10 lbs. per thousand barrels for Venezuela crude, to 125 lbs. per thousand barrels for Mexican crude.

Because of the nature of the plant -- asphalt production -- very few raw materials are used. The only significant import is caustic which is used to reduce sulfides. Small quantities of ammonia and amine are purchased for corrosion control.

## 4. Capacity:

This plant has the capacity for refining 14,000 barrels (42 gallon barrel) of crude oil per stream day. Normal wintertime operation is approximately 9,000 barrels per stream day. The peak rate is reached during the summer months when the demand for paving asphalt is high.

## 5. Operations:

Since this plant is designed for asphalt production, cracking of crudes and intermediates is avoided. Essentially, the plant utilizes straight steam distillation -- one atmospheric and one vacuum column. Vacuum is created on the vacuum still by Elliot Company type steam jets.

Operating temperatures are kept below 700° F in the atmospheric column and 800° F in the vacuum column so as to prevent cracking. Steam is supplied at the rate of 2,000 lbs. per hour to the vacuum still and at 2,800 lbs. per hour to the atmospheric column.

The plant operates 24-hours a day, 7-days a week, 11-months a year. The installation shuts down for one month during the wintertime for maintenance. Industrial asphalts for roofing are run year round and paving asphalts, used for roads, are run during the warmer months.

The tank farm is supplied by the Colonial Transcontinental Pipeline. This is a completely separate operation from the asphalt plant.

## 6. Water Supply:

Two sources of water are available, namely, Arthur Kill and the Elizabethtown Water Company. Elizabethtown water is used for drinking, sanitary purposes and steam production. A Zeolite softener is used to condition boiler feed water. The bulk of water for the refinery is pumped from the Arthur Kill and is used for cooling purposes. Approximately 0.36 million gallons per day of fresh water and 7.2 million gallons per day of salt water are used by the plant. The quality of the Arthur Kill water presently satisfies the needs of the plant. No problems have been encountered with corrosion or clogging as a result of these waters being used for cooling.

A chlorination system, which was originally provided, has been discontinued since experience at the plant has shown that this treatment is not necessary. Cooling water from the Arthur Kill is handled by one electric-driven, 4,000 gallon per minute pump, and one 800 gallon per minute unit tied in with the process blending equipment. A steam operated 4,000 gallon per minute unit, has been provided for standby operation. This unit is used approximately once per week while the screens of the electric driven unit are cleaned.

7. Sewerage:

All sanitary wastes from the facility are handled in a septic tank and tile field system. All cooling waters and process waters are handled in one sewer system. Storm runoff from the tank fields in the immediate area of the refinery also discharges to the same sewer system. To prevent purging, the tank fields are valved to permit bleeding of the runoff into the sewer.

The total refinery effluent averages 5,000 to 6,000 gallons per minute, exclusive of the sanitary wastes volume. It is discharged through three 12" diameter pipelines located in the Arthur Kill bulkhead. These discharges are located at the northeast corner of the refinery property and approximately 1,500 feet from the raw water intake.

8. Principal Processes:

Principal processes at the Cities Service Refinery are:

Atmospheric distillation
Vacuum distillation
Treating (Gasoline sweetening, Bender Process)
Oxidation
Cutback Blending

## WASTES CHARACTERISTICS

Generally speaking, the amount of non-hydrocarbon constituents in the petroleum may be taken as a fairly good criterion of the extent of treatment required to produce marketable products. The principal impurities in petroleum include: free sulfur, hydrogen sulfide, sulfur compounds, nitrogen, and oxygen. The asphaltic and resinous bodies which are present in various amounts in most crude are considered to be formed in part, by the oxidation and polymerization of certain hydrocarbons in crude oil. Process wastes from a petroleum refinery may be expected to contain various chemicals used in treatment of petroleum products, combined with the impurities referred to, together with oil in various stages of process. Many of these wastes are relatively small but their effects on the refinery effluent are accumulative.

The most offensive constituents in refinery wastes, from the standpoint of pollution, are believed to be phenols, mercaptans, nitrogen bases, naphthenic acids and oil. With the exception of oil, these most offensive substances are normally concentrated in the wastes resulting from chemical treatment. The overhead receiver water from catalytic cracking units is a significant source of phenol.

However, the foregoing statements refer to petroleum refineries processing full range crude oils and employing cracking operations.

The operation of this asphalt plant and the products formed during processing are contrary to the general ideas stated above. This refinery, being an asphalt plant, is operated to reduce the low gravity crudes to a heavy tar called asphalt. To do this, cracking conditions are avoided. As a result of this type of operation, there are no unusual products formed during processing. That is, only minor quantities of phenols and ammonia are formed in the refinery. Although the crude process is high in sulfur content, the sulfur remains in the asphalt and thus enhances the quality of this product. Tests indicate that there is 5.2% sulfur by weight in the finished product.

Emulsions formed in refining operations are predominantly oil-in-water emulsions or systems of oil dispersed in water, the water constituting the external or continuous phase. Emulsion problems have reportedly been reduced by keeping the caustic segregated from other waste streams. Approximately 4,000 gallons of waste caustic is sold to a vendor every six weeks. This waste caustic is from the Bender Treater which sweetens gasolines by converting mercaptans to disulfides which are soluble in oil.

## WASTE TREATMENT PRACTICE

Cities Service Oil Company has taken cognizance of the value of oil wasted through the sewers and the damage resulting from oil pollution. In 1958 a completely new treatment system was installed and in 1960 the oil separator was modified. Plans are now being prepared for installing flow metering and sampling equipment.

### 9. Oil-Water Separators:

The Cities Service Oil Company has one A.P.I. oil-water separator located above grade. It is divided into three parallel sections, each approximately 20 feet wide by 156 feet long and has an approximate water depth of 7 feet. Each section has three settling compartments -- 22 foot long inlet chamber; 66 foot long primary basin; 68 foot long secondary basin. Every compartment contains its own sludge collecting and skimming mechanism, sump, and auger type sludge conveyor.

In 1960 the oil-water separators were remodelled. Reaction jets were installed on each of the five 12-inch diameter inlet pipes in the primary and secondary basins of all separators. Essentially, these jets consist of a curved deflector plate, approximately one inch larger than the diameter of the pipe, installed three inches away from the inlet pipe. As wastes enter the tank through the pipes they deflect off the plates and back on to the tank wall, thus creating laminar flow at the tank inlet.

Skimmings from the separators are pumped to two small circular settling tanks where further separation is accomplished. The water from these settling tanks is returned to the settling pit (old separator) for further treatment and decanted oil is pumped to the slop tanks. Sludge from the separators (flights operated approximately twice per 24 hour day, and solids removed once per week) is pumped to the plant's settling pit (old separator), which is now used only to provide additional settling time. Skimmings from the settling pit (old separator) are pumped to a slop tank. Approximately once every six weeks a contractor is brought in to remove the settled sludge.

There is presently no flow indicating or recording device at the plant. Flow records are based on raw water pumpage. It is estimated that wastes flow is approximately 5,000 gallons per minute. An additional 1,000 gallons per minute is added during wet weather flow.

10. Spent Chemicals:

Spent caustics are collected in a tank truck and sold to a vendor.

11. Analytical Results:

Oil samples are routinely collected from all three discharge pipes by refinery personnel. Oil results vary slightly from season to season. Data for the past four years indicate that the oil concentration averages approximately 15 parts per million with peaks of 50 parts per million. A noticeable increase in oil recovery from an average of 50 parts per million down to 15 parts per million resulted after 1960 when the Reaction jets were installed in the separators. The present oil load to the Arthur Kill is approximately 900 lbs. per day.

During the past two years refinery results indicate that the phenol concentration in the effluent is less than 40 parts per billion, which is equivalent to 2.4 lbs. per day.

BOD's of the effluent are run routinely, once or twice per month, on each of the separator effluents. It appears, based on Cities Service data, that the plant is contributing approximately 20 parts per million or 1,200 lbs. of BOD per day to the Arthur Kill.

## WATER POLLUTION ABATEMENT PROGRAM

Attention was invited to the fact that salt water, used at the Cities Service refinery, complicated both analytical procedures and pollution abatement measures. It is estimated that during dry weather over 95% of the flow through the oil-water separators is brackish.

The waste control and water pollution abatement program at the refinery presently calls for installing an automatic effluent sampler, the combining of all three effluent discharges into one common line, and the installation of a Parshall flume.

## Hess Oil & Chemical Company, Port Reading Refinery

## Port Reading, N.J.

### 1. Organization:

The Hess Oil Refinery, located in Port Reading, New Jersey, directly on the Arthur Kill, consists of approximately 65 acres including tank farm area. The plant layout is compact with little open space in the process area.

The refinery was constructed in 1958 and expanded in 1961. The plant is automated to the maximum possible and employs a figure well below the national average of 11 persons per 1000 barrels of crude per day. Published material describing this refinery can be found in the annual Oil and Gas Journal Survey.

### 2. Products:

The Port Reading Refinery produces only petroleum products. Petrochemical production by Hess Oil Company is accomplished at the company's Corpus Christi, Texas refinery. The products of the Port Reading Refinery are:

Pitch (residual)
Home Heating Oil #2
Jet Fuel
Gasoline
LPG

The only plant by-product is sulfur from the sulfur recovery process.

### 3. Raw Materials:

The refinery is designed to process sweet crude only and efforts to utilize sour crude generally have been unsuccessful. More than 60% of the raw materials are U.S. coastal crudes with a sulfur content of 0.35% or less. Additional sweet crude is obtained from Venezuela fields.

Processing chemicals used are limited to caustic, acid, and organic inhibitors.

### 4. Capacity:

The refinery has a design capacity of 65,000 barrels of crude oil per day. Under normal operations plant capacity can be slightly higher than this figure. On the date of the Public Health Service visit the plant was running at capacity.

5. Operations:

The major process operations are as follows:

Crude Distillation
Reforming (Platinum catalyst)
Desulfurization (Cobalt Molybdenum catalyst)
Fluid catalytic cracking
Gas recovery for LPG manufacture
Alkylation (Sulfuric Acid catalyst in closed system)
Caustic scrubbing (gasoline and #2 fuel oil)

Spent caustic is recovered and sold or dumped at sea. Used sulfuric acid is recovered and returned to the acid vendor for regeneration.

The plant operates continuously and has a 95% service factor based on a 24-hour day, 365-day year.

6. Water Supply:

Water is obtained from two sources, the Middlesex Water Company and the Arthur Kill.

Arthur Kill water is utilized only for fire and wash-down processes; use is estimated at 50 to 100 gpm. A 2,000 gpm pump operates approximately two to eight hours per day to maintain pressure in the fire and wash-down lines.

The bulk of the water utilized in the refinery is purchased from Middlesex Water Company. Approximately 60 gpm is utilized for drinking and sanitary purposes, and an additional 80 to 120 gpm is used for process water. The plant utilizes a closed cooling water circuit and requires 800 to 1,000 gpm of Middlesex water for make-up purposes. The only treatment given water is in the cooling system. The refinery has two towers operated by other companies, one utilizing a mixed chromate-phosphate treatment, the second a chromate. An additional 300 gpm is purchased from Middlesex Water Company for use in the company's steam plant. Company records indicate an average of 1,345 gpm of water is purchased from the Middlesex Water Company.

7. Sewerage:

There are three separate sewer systems within the refinery as follows:

a. Sanitary wastes to the Sewaren Municipal Treatment Plant
b. Storm water drains
c. Oily water sewers

Oily water sewerage is passed through an API separator to a holding pond; storm water drains discharge directly to the holding pond. From the holding pond, effluent is pumped to the Arthur Kill.

8. Other Utilities:

Electricity is purchased from the Public Service Sewaren Generating Plant adjacent to the refinery. The Public Service Plant purchases "residual" fuel oil from the refinery.

The refinery operates its own steam plant equipped with 4 Titusville boilers and operating at about 260 lbs. pressure head. Approximately 300 gallons per minute of water is purchased from Middlesex Water Company for make-up in the steam plant.

## WASTES CHARACTERISTICS

The amount of non-hydrocarbon constituents in petroleum may be taken as a fairly good criterion of the treatment required to produce marketable products. The principal impurities in petroleum include: free sulfur, hydrogen sulfide, other sulfur compounds, nitrogen and oxygen. The asphaltic and resinous bodies which are present in various amounts in most crude are formed in part by the oxidation and polymerization of certain hydrogen compounds in the crude. Petroleum refinery wastes may be expected to contain various chemicals used in the treatment of petroleum products as well as the impurities referred to above and oil in various forms. Many of these wastes are relatively small but their effects on the refinery effluent characteristics are accumulative.

The most offensive constituents in petroleum refinery wastes, from the standpoint of water pollution, are believed to be phenols, mercaptans, nitrogen bases, naphthanic acids, and oil. With the exception of oil these substances are normally concentrated in the wastes resulting from chemical treatment. For example, the overhead receiver water from catalytic cracking units is a significant source of phenol.

Light distillate oils may contain hydrogen sulfide, low molecular weight naphthenic acids, phenol compounds, mercaptans, and other sulfur compounds. Organic nitrogen compounds may be present in low concentrations. Emulsions formed in refining operations are predominantly oil and water with the water constituting the external or continuous phase.

## WASTES TREATMENT PRACTICE

Hess Oil & Chemical Company in the design and construction of the Port Reading Refinery has taken cognizance of the value of oil which could be lost through sewers as well as possible water pollution from oil and other pollutants. In addition to incorporating necessary treatment facilities for oil recovery and pollution abatement, the company followed the most modern available design considerations so as to prevent comingling of various wastes which might result in troublesome emulsions.

9. Waste Sources and Treatment:

The major source of phenol is the overhead receiver water from the cat cracker which averages 100 mg/l phenol and amounts to 25 to 40 gpm in volume. On an experimental basis the refinery has obtained 90% phenol reduction from this source by utilizing the receiver water in desalting processing. Before attempting the desalting as a reduction means, the plant waste stream entering the API separator averaged 1 to 10 mg/l of phenol. No data are available since the desalting experiment was begun.

The other major phenol source is draw-off from the tank fields. This liquid waste is discharged directly to the holding pond and would result in a peaking effect of phenols when draw-off is accomplished.

Sulfide and hydrogen-sulfide removal is accomplished by a UOP sulfide stripper using flue gas and steam. This unit treats the overhead receiver water from the cat cracker and caustic wash from the alkylation process. The stripper has shown good sulfide and hydrogen-sulfide removal but has little effect on phenol concentrations.

An analysis by an outside firm of the overhead receiver water which was sampled in November, 1964 showed the following results:

| ITEM | CONC., mg/l |
|---|---|
| Phenol | 76 |
| COD | 100 |
| pH | 7.9 |
| Alk M.O. | 1900 as $CaCO_3$ |
| Total Solids | 4 |
| $H_2S$ as S | 1210 (.121%) |
| Mercaptan as S | 10 |
| Color, APHA Pt-Co | 45 |
| Turbidity | Clear |
| Ammonia as $NH_3$ | 7000 (0.70%) |
| Chloride as Cl | 13 |
| Sulfate as $SO_4$ | 8 |
| Cyanide, ppm CN+CNS | 4.3 |
| Oil | Not run |

The waste treatment system consists of an API oil separator followed by a holding pond. The API separator consists of two parallel bays each 13' wide by 106' long (effective settling length) and a mean liquid depth of 5'. Average flow to the separators is 250 gpm. Both bays are equipped with flight scrapers, skimmers and baffled inlets. The bays are utilized alternately rather than in parallel so as to permit cleaning one bay while the second is in use. Slop oil from the separators runs from 158 to 277 barrels per day with 30% to 50% water. This is held in slop tanks until sufficient volume is available at which time it is pumped to the crude storage tanks. In addition to a very small amount of slop oil from the plant, the separator also receives pumpage from various customers and occasional sludge from the tank farms when these are cleaned. No routine check is made on the separator operating efficiency. As sludge accumulates in the separator it is pumped and trucked away under contract. A visual inspection was made of the separator operation. A heavy passage of oil through the separator was noted due to a build-up of sludge in the separator tanks. From the separator, effluent flows by gravity to a holding pond approximately 300' long by 200' wide. The holding pond effluent passes through four pairs of hay-filled screens. These screens are generally cleaned monthly depending upon the amount of head loss noted. From the holding pond, plant effluent is pumped to a submerged discharge to the Arthur Kill. In addition to the separator line the holding pond also receives other discharge lines including storm water drains and tank farm drainage. Inspection of the holding pond showed a considerable amount of oil present with some signs of the formation of sludge deposits in the pond, probably attributable to excess oil from the separators.

Visual examination of the pump effluent discharge from the holding pond indicated no readily apparent oil slick on the Arthur Kill from the submerged outlet.

10. Analytical Results:

The refinery performs limited analyses of the final effluent from the holding pond. Grab samples are taken every few weeks and sent for analysis by an outside firm. Hess Oil does check for sulfide and pH. Analytical results indicated the following ranges:

phenol--1 to 10 mg/l
COD--several hundred
sulfide--0
chromate--0
chloroform extractables--22 to 68 mg/l
  (but one sample 121 mg/l)

## WATER POLLUTION ABATEMENT PROGRAM

The Hess Oil & Chemical Company refinery is continuing its efforts in waste control and water pollution abatement. A pilot plant study is under consideration to develop secondary treatment for phenols in drainage from the tank farm. The company plans to continue its work in the reduction of phenol from the cat cracker overhead receiver water by the use of this water in the desalting process.

# California Oil Company

## Perth Amboy, New Jersey

1. Organization:

This refinery is operated by the California Oil Company, which is a wholly owned subsidiary of the Standard Oil Company of California. Full ownership of the refinery was acquired in 1948. The California Oil Company serves 12 Eastern States from Maine to Virginia.

This refinery has been completely rebuilt in recent years. Most of the old process equipment has been dismantled. The refinery is located at the north edge of Perth Amboy some 2 miles upstream from the point where the Arthur Kill enters Raritan Bay.

The Standard Oil Company of California is represented by Mr. John Easthagen on the American Petroleum Institute Committee on Disposal of Refinery Wastes. Mr. Easthagen serves as consultant to all refineries within the company on matters pertaining to liquid waste disposal.

2. Products:

Principal products run at the refinery are:

a. aviation gasoline

b. motor gasoline

c. liquified petroleum gas (LPG)

d. solvents (hexanes, heptanes, etc.)

e. kerosene

f. #2 fuel oil

g. #4 fuel oil

h. #6 fuel oil

i. paving asphalts

j. asphalt cutbacks

Refined products are shipped to various distribution points and to consumers via tank ship, pipeline, barge, and tank truck.

3. Raw Materials:

This refinery was originally intended to process principally Arabian crude. Crude is presently received principally from Arabia, Venezuela, and the Gulf Coast area. Crude oil is received at the refinery exclusively via tank ship.

The sulfur content of the crude oil averages about 1 to 2 percent by weight. It was pointed out that much of the sulfur in the crude oil ends up in asphalt residual.

The salt content of the crude oil averages about 15 pounds per 1,000 barrels. An electrostatic system is employed in desalting.

Crude oil is the principal raw material. Other raw materials include ammonia for corrosion control and caustic for chemical treatment of certain products.

4. Capacity:

This refinery is running about 70,000 barrels (42-gallon barrels) of crude oil per calendar day. This would approximate 75,000 barrels per stream day. The Standard Oil Company of Kentucky, another subsidiary of the Standard Oil Company of California, has recently built a petroleum refinery in the State of Mississippi. There are no plans for expanding the refinery at Perth Amboy.

A phthalic anhydride plant was built in 1962. Phthalic anhydride is the only chemical manufactured. There are no immediate plans for petro chemical expansion.

5. Operations:

The crude units, cracking unit, and auxiliary equipment operate continuously. Other refining and treatment processes are likewise continuous. The refinery operations should be considered as being on a 24-hour day, 7-day week basis.

6. Employees:

There is a total of 900 employees, including office personnel and operating staff.

7. Water Supply:

There are three sources of water supply, namely; Arthur Kill, two company wells, and the Perth Amboy public water supply.

A pump station located on the Arthur Kill draws salt water from this source at a rate of about 30,500 gallons per minute for circulation as cooling water to various units. In order to reduce salt water intake and effluent volume, two salt water cooling towers are in operation for cooling some 20,000 gallons per minute of salt water for reuse as cooling water in various process units. There is no chemical treatment of the Arthur Kill water.

Production of the two company wells is restricted by the State Water Policy Board. These wells were reported to average 325 gpm. City water averages 1.4 mgd. City water goes to boiler feed make-up and limited process use. The attached diagram of process water system depicts water use within the refinery. Arthur Kill water was reported satisfactory for refinery use. Trouble was reported recently from a large accumulation of plastic bags on the screen at the river intake.

8. Sewerage:

There are four separate sewer systems designated as:

a. Sanitary sewer

b. Storm sewer

c. Clean water sewer

d. Oily water sewer

These systems are indicated on the attached diagram which is designated, "Effluent Water Treatment Facilities, California Oil Company." Sanitary wastes are discharged to the Perth Amboy sewerage system for treatment. Treated refinery process waste waters and cooling waters are discharged to Woodbridge Creek, which is tributary to the Arthur Kill.

## REFINERY PROCESSES

The principal refining processes are shown on the attached flow diagram. The crude units include two vacuum pipe stills in which the vacuum is created by barometric condensers. The catalytic cracking unit is a Houdriflow type and makes use of a bead catalyst.

Light hydrocarbon gases are conveyed to the Anlin Company, adjacent to the refinery, for removal and recovery of sulfur. The desulfurized gas is returned to the refinery for production of steam and power. Liquified petroleum gas is desulfurized by fractionation and caustic scrubbing and is dried by an alumina absorbent. Gasoline is chemically treated to convert mercaptans to disulfides. Entrained caustic containing water from certain intermediate gasoline storage tanks is combined with spent caustic for disposal at sea. Kerosene is desulfurized by the Perco process which makes use of a solid bed of cupric chloride.

## WASTE WATER TREATMENT

Concerted effort is made to keep spent chemicals out of the refinery sewers. These concentrated wastes are disposed of in the ocean, being transported by oil tankers returning to Arabia for crude oil. California Oil Company, in recent years, has spent over 1 million dollars on waste treatment facilities at the Perth Amboy refinery.

### 9. Oil-Water Separators:

It will be apparent from the foregoing that the principal liquid waste problem at this refinery is the separation of oil products from water. Considerable thought has been given to oil-water separation and a rather flexible system has been devised. This system is shown diagrammetically on the attached sketch designated, "Effluent Water Treatment Facilities."

These oil-water separators are described in detail in material submitted by the New Jersey Department of Health. This material provides information on sources of wastes, equipment description, and operation. It was reported that reduction in water use had reduced flow to #2 API separator from 18,000 gpm to 12,000 gpm. Likewise, flow to #3 separator is presently 4,000 gpm instead of 6,000 gpm as shown on the diagram.

### 10. Operation of Separators:

There were some irregularities in the operation of these oil-water separators at the time of our visit. Mention is made of these observations as a matter of record. The north compartment of the west half of the #2 separator was inoperative. It was estimated that 75 percent of the flow reaching the #2 separator was being diverted through the east half of the unit. There was very little oil reaching the #2 separator and it would appear that one-half of the #2 separator might provide adequate capacity for this particular flow.

The #3 oil-water separator appeared to be overloaded, both hydraulically and on the basis of accumulated oil. Efficiency of the #3 separator was believed influenced by pumping water from the adjacent oil bin to the separator inlet by means of an ejector. Handling of oil recovered by the #3 separator was complicated by the absence of an oil pump which was out of service for maintenance. Each compartment of the #3 separator contained a significant accumulation of oil and there was evidence of oil in the effluent from this unit.

There was substantial accumulation of oil floating on the south half of the 13-acre settling basin (lagoon). Plans are under way to provide a skimmer for oil accumulating in the first half of this settling basin. Oil accumulated on the surface of this settling basin drains to the surge pond from which it is pumped to the #4 separator inlet. This surge pond pump was operating at the time of our visit.

Based on observations at the time of our visit, it appeared that the #2 separator was operating under capacity and the #3 separator was overloaded. Short-time efficiency studies of these separators will either confirm or disprove this theory. It was reported that slop oil recovery averaged 200 barrels per day water free oil. Sludge pumped from the oil-water separators is disposed of in a pond on refinery property. Maleic acid from phthalic anhydride production is incinerated. See comment below by California Oil Company.

"Comment is made regarding irregularities in the operation of No. 2 and 3 separators at the time of your visit. It was noted that the north compartment of the west half of No. 2 separator was inoperative. This was due to a routine bin cleaning operation. However, as was noted, effluent water was clear, indicating that the separator had sufficient capacity to absorb the cleaning operation without unduly reducing separating efficiency.

It was also noted that effluent water from No. 3 separator contained traces of oil. This was due to mechanical failure of a pump which lifts influent oily water from a collection bin to the separator. An eductor was being used temporarily for this service, which caused excessive agitation of the oily influent water and made oil separation in the separator less efficient than normal. However, effluent from this separator goes to a large settling and oxidation basin before discharge to Woodbridge Creek. The basin effluent was observed to be visibly free of oil during your visit, further illustrating the efficiency and value of this facility as a final clean-up for our oily water stream. The pump in question on No. 3 separator is now back in service and the separator is back to normal and satisfactory operation."

11. Pollution Parameters:

Effluents from this refinery are routinely checked for:

a. oil - total and volatile

b. biochemical oxygen demand

c. phenols

d. sulfides

e. pH

A pump has been installed for manual sample collection within the outlet from the settling basin to Woodbridge Creek. Samples are collected at this point daily and analyzed for sulfides and pH. Sulfides normally run less than 0.1 ppm. All five determinations listed above are run at least once a month.

Based on available data, it was estimated that oil losses from this refinery approximated 270 gallons per day. Likewise, it was estimated that phenol losses should average 25 pounds per day.

Progress in pollution abatement by this refinery is evidenced by the reduction in BOD of the effluents. This improvement is shown in the table designated, "Biochemical Oxygen Demand, Effluent Process Water, California Oil Company," dated May 19, 1965.

## The American Agricultural Chemical Company

## Carteret, New Jersey

### 1. Organization:

The American Agricultural Chemical Company is solely owned by Continental Oil. It operates 35 plants extending from the eastern seaboard into Kansas, with the home office at 100 Church St., New York, N.Y. The fertilizer plant has operated at this location in Carteret since around 1890 and the American Agricultural Chemical Company has been operating here from the turn of the century. As far as classification of chemical industry is concerned there are two distinct operations on the premises. One set of facilities is devoted to the manufacture of chemical fertilizers and the other set of facilities is devoted to production of chemical phosphates. The plant is located in the northern part of Carteret, New Jersey, abutting the Arthur Kill.

### 2. Products:

The chemical fertilizer facilities produce a complete line of mixed chemical fertilizers and a by-product, ammonia silicofluoride.

The chemical phosphate facilities produce phosphorus pentasulfide and sesquisulfide, sodium tripolyphosphate, and tetrasodiumpyrophosphate, di-and trisodium phosphate, and phosphoric acid.

### 3. Raw Materials:

The raw materials for the chemical fertilizer operations are ammonia solutions, triple superphosphate, potash, phosphate rock or phosphorite, anhydrous ammonia, sulfur, and waste organic material such as hair, wool, fur, and leather scraps.

The raw materials for the chemical phosphate operations are elemental phosphorus, soda ash, and caustic.

### 4. Capacity:

The production of these facilities is highly variable and the capacity is considered to be confidential information.

### 5. Operations:

The usual schedule of operations for the various processes are indicated on the individual flow charts which accompany this report.

6. Employees:

The employment at these facilities varies from 200 to 300 with a normal employment of 240.

7. Water Supply:

Fresh water is purchased from the Middlesex Water Company and sea water is pumped from the Arthur Kill. The water use in the various processes are indicated on the individual flow charts.

8. Sewerage:

All sanitary sewage and some waste process water as indicated on the individual flow charts is discharged to the municipal sewer system. Other waste waters as indicated on the individual flow charts are discharged to the Arthur Kill. There are three main outlets to the Arthur Kill. One of these, bearing all wastes from operations other than the sulfuric acid plant, are discharged to the Arthur Kill in the vicinity of the south end of the dock. The waste waters from the sulfuric acid plant are discharged to a natural water course at the south edge of the property. A third line bearing wastes from the power plant and runoff from the land disposal area discharges to the Arthur Kill at the north edge of the property. A storm sewer discharges to the Arthur Kill underneath the dock and it is reported that there are not any process wastes in this pipe.

9. Outline of Processes:

In the fertilizer production, sulfuric acid is produced from the burning of elemental sulfur in the chamber process. This acid is used to produce superphosphate fertilizer from phosphate rock. The organic raw material is used in the agrinite process to produce a material for the mixed fertilizers. In the production of mixed fertilizers the base material is mixed dry and charged to the TVA ammoniator where it is mixed with water, ammonia solutions, and sulfuric or phosphoric acid. This mixture is dried, screened and cooled to produce various grades of mixed fertilizers.

The by-product ammonia silicofluoride is produced from anhydrous ammonia and waste hydrofluosilicic acid from the production of superphosphate.

In the production of chemical phosphates, phosphoric acid is produced from the combustion of elemental phosphorus. The phosphates are produced from phosphoric acid, soda ash, and caustic soda, while the phosphorous sulfides are produced from elemental phosphorus and elemental sulfur, as indicated on the individual flow charts.

## SOURCES OF WASTES

10. Ammonia Silicofluoride Process:

There are two sources of wastes in this process, one liquid and one solid. A vacuum is pulled on the evaporator in this process by means of a jet ejector and the exhaust steam is cooled with approximately 300 gallons per minute of salt water. There is a potential source of pollution in this operation that the ammonia silicofluoride solution may be entrained in the cooling water. Based on the experience at other plants the local management does not believe that they are adding fluoride to the cooling water, but is unable to analyze for this material in the presence of other halides which are already present in sea water. When the fluosilicic acid is filtered, silica is removed as filter cake and it is estimated that approximately 1/10 of 1 percent of fluosilicic acid is lost with the cake. The cake is disposed of on ground to the north of the plant property. There undoubtedly is some surface runoff from this disposal area.

## 11. Phosphoric Acid Process:

In the existing phosphoric plant phosphoric acid leaks from the equipment into the circulating cooling water. This acid is neutralized with caustic in order to control the pH in the circulating water system. The slime in the cooling tower is controlled with chrome salts. The blowdown from the cooling tower amounts to a flow of approximately 25 gallons per minute and, of course, contains the concentrated chrome salts and phosphates.

## 12. Phosphate Crystallizer:

In the production of the sodium phosphates the crystallizer is operated under vacuum which is maintained by a jet ejector and the steam from the ejector is condensed with salt water flowing at about 300 gallons per minute. There is a potential water pollution here if there should be entrainment from the crystallizer. Management reports that they make spot checks on this effluent for phosphates and entrainment has not been found.

## 13. Runoff:

The fertilizer operations at this facility are essentially dry operations and there is a good deal of dust about the premises, both on the roofs and ground surfaces. Obviously, in case of rainfall some of this material can be carried along with the surface runoff. The magnitude of this source of pollution with nitrogen and phosphorus is not known.

## 14. Ship Unloading:

Approximately six vessels per year are unloaded at the plant docks. Such material as potash, phosphate rock, and triple superphosphate are received by ship. The material is unloaded from the ship by means of buckets and small cars. Occasionally there is some spillage from the cars if they are loaded too full, but this can be controlled. Wind at the time of unloading blows some of the material onto the dock and into the Arthur Kill. This may be on the order of six tons per ship load of material. The quantity of the material cannot be measured by difference in shipped and received weights.

## WASTE CONTROL

15. Superphosphate Process:

At the time of this survey the dust from the grinding of rock was being settled and then scrubbed with wastewater going to the Arthur Kill. During 1966, a bag collector is to be installed and the wastewater will be eliminated.

Hydrofluosilicic acid is recovered from the acidulation of the phosphate rock.

The off gas from the present scrubber for the recovery of hydrofluosilicic acid is to be treated in a Venturi scrubber and the water will be used in the present scrubber.

16. Granular Mixed Fertilizer Process:

During 1966, several improvements for better air pollution control are to be made in the fertilizer plant.

The vent gases from the dryer are to be discharged to a cyclone instead of the dry bag dust collector and the solids returned to the mixer. The vent gases from the ammoniator and the new cyclone are to be discharged to a Venturi scrubber and the wash water returned to the ammoniator.

The screens and the cooler are to be vented to a dry bag dust collector, eliminating the cyclone for the cooler.

17. Phosphoric Acid Process:

The existing acid plant leaks acid to the recirculating water system which bleeds to waste. The entire phosphoric acid plant is being replaced.

18. Sodium Phosphates Process:

All of the recirculating water on the scrubber is bled back to process.

19. Poly Phosphates Process:

The wastewater from the scrubber is fed to the mixer.

The city water in the cooling screw is not exposed to process material. (Flow diagrams of all processes have been supplied by the company)

## E.I. du Pont de Nemours & Company, Inc., Graselli Plant

## Linden, N.J.

### 1. Organization:

This industrial complex located on 100 acres adjacent to the Arthur Kill in Linden, N.J., was obtained by du Pont in 1928. The plant, which began operation in 1884, was originally owned by Standard Chemical. Approximately 450 people are employed at this location.

### 2. Products:

List of Finished Products

Aluminum Chloride
Aluminum Sulfate, I.F.
Anisole Technical
Aqua Ammonia
Chlorosulfonic Acid
Hydrochloric Acid
Methoxychlor
Nitric Acid
Reagent Ammonium Hydroxide
Reagent Nitric Acid
Reagent Sulfuric Acid
Salt Cake
Sodium Bisulfite Solution
Sodium Silicate
Sodium Styrene Sulfonate
Sodium Thiosulfate
Strontium Nitrate
Sulfamic Acid
Weed & Brush Killer
Ammonium Sulfamate
Flame Retardants
Sulfuric Acid
Sulfur Trioxide
Dimethyl Hydroxy Amine
Dimethyl Sulfate

### 3. Raw Materials:

List of Raw Materials

Acetic Acid
Aluminum Trichloride
Ammonia Anhydrous
Ammonium Phosphate Di-
Ammonium Sulfamate
Ammonium Sulfate
Boric Acid
Bromine
Carbon Bisulfide
Caustic Soda
Celestite Ore
Chloral
Chlorine Liquid
Dicyandiamide
Ethylene Diamine
Heptane
Hydrochloric Acid
Hydrogen Peroxide
Lime Chemical
Methylene Chloride
Nitric Acid
Phenol
Salt (NaCl)
Sand
Soda Ash
Sodium Bichromate
Sodium Bisulfite
Sodium Nitrite
Sodium Thiosulfate
Strontium Carbonate
Styrene
Sulfamic Acid
Sulfur
Sulfuric Acid
Urea

4. Capacity:

Plant outputs are considered confidential.

5. Operations:

The Grasselli complex is divided into ten separate manufacturing areas:

1) Organic Area: Manufacture of miscellaneous organic intermediates and agricultural products. Several Operations are seasonal and operate 8 to 12 weeks per year. All operations produce 24 hours per day, 7 days per week when on stream. Products include the organics indicated on our product list. This area contributes all the miscellaneous organic waste listed including the phenolics. It is a minor contributor (5%) to the total acidity and nitrite-nitrate nitrogen; a 10-15% contributor to the ammonia + organic nitrogen.

2) Strontium Area: Manufacture of strontium nitrate and strontium carbonate. Operations are 24 hours per day, 7 days per week. This area produces the largest portion of the nitrite-nitrate nitrogen waste; however, the ratio of nitrate to nitrite is 99 to 1 respectively.

3) Hydrochloric Area: Manufacture of various grades of hydrochloric acid and salt cake. Operations are continuous. Acidic wastes are neutralized.

4) Amine Area: Do not manufacture amines; strictly an area for the preparation of amine solutions of various strengths by the dilution of anhydrous amines with water. Operations are 1 shift per day, 5 days per week. A fair contributor (20%) to the ammonia + organic nitrogen waste.

5) Central Area: Manufacture of sodium thiosulfate which operates 24 hours per day, 5 days per week; aluminum sulfate which operates 24 hours per day, 7 days per week; and aluminum chloride which operates 16 hours per day, 5 days per week. The former contributes the reducing inorganic salt waste, while the latter two contribute a negligible amount of acidic waste.

6) Sulfamic Area: Manufacture of sulfamic acid and its associate products. The latter includes ammonium sulfamate, the flame retardants, and the weed-brush killer. The area is in operation 24 hours per day, 7 days per week. It is a major contributor to the total acidity and ammonia + organic nitrogen categories.

7) Silicate Area: Manufacture of glass and various grades of sodium silicate solutions. Operations are 24 hours per day, 7 days per week. A negligible contributor to the waste picture.

8) CP Reagent Area: Manufacture and package various reagent grade commodities. These include reagent grade ammonium hydroxide, nitric acid, sulfuric acid and hydrochloric acid. The area operations section is producing 24 hours per day, 7 days per week. The area is a very minor contributor to the waste profile.

9) CSA - SO3 Area: Manufacture of chlorosulfonic acid and sulfur trioxide. Operations are 24 hours per day, 7 days per week. This area is a significant contributor to the total acidity category.

10) Sulfuric Area: Manufacture of various strengths of sulfuric acid. Operations are 24 hours per day, 7 days per week. This area contributes a very minor quantity of acidic waste to the stream pollution picture.

## OPERATIONS

| AREA | AREA PRODUCTS | Hours/Day | Days/Week | TYPE OF WASTE | QUANTITY |
|---|---|---|---|---|---|
| ORGANIC | Miscellaneous Organic intermediates and agricultural products. | 24 Hrs.<br>Some seasonal operations. | 7 Days | Miscellaneous organic | 100% |
| | | | | Phenolics | 100% |
| | | | | Total Acidity-Nitrogen | Minor (< 5%) |
| STRONTIUM | Strontium Nitrate<br>Strontium Carbonate | 24 Hrs. | 7 Days | Nitrite - Nitrate Nitrogen | Major portion but 99 to 1 ratio $NO_3^-$ to $NO_2^-$ |
| HYDROCHLORIC | Hydrochloric Acid and Salt Cake | 24 Hrs. | 7 Days | Acidic-Neutralized | Minor |
| AMINE | Amine Solutions | 8 Hrs. | 5 Days | Ammonia + Organic N | 20% Range |
| CENTRAL | Sodium Thiosulfate | 24 Hrs. | 5 Days | Reducing Inorganic salts | 100% |
| | Aluminum Sulfate | 24 Hrs. | 7 Days | Acidity | Negligible |
| | Aluminum Chloride | 16 Hrs. | 5 Days | Acidity | Negligible |
| SULFAMIC | Sulfamic Acid and Associate Products | 24 Hrs. | 7 Days | Acidity as $CaCo_3$ | Major (70%) |
| | | 24 Hrs. | 7 Days | Ammonia + Organic N | Major (80%) |
| SILICATE | Glass and Sodium Silicate Solutions | 24 Hrs. | 7 Days | Silicates | Negligible |
| CP - REAGENT | Reagent Grade Acid and Ammonium Hydroxide | 24 Hrs. | 7 Days | Acidity as $CaCo_3$ | Minor (<5%) |
| | | | | Ammonia N | Negligible |
| CSA - $So_3$ | Chlorosulfonic Acid and Sulfur Trioxide | 24 Hrs. | 7 Days | Acidity as $CaCo_3$ | Major (3%) |
| SULFURIC | Sulfuric Acids | 24 Hrs. | 7 Days | Acidity as $CaCo_3$ | Negligible |

6. Water Supply:

Two sources of water are available, namely the Arthur Kill and the Elizabethtown municipal supply.

Arthur Kill - Approximately 10 mgd of salt water is used for cooling. More than 90% of this volume is used on a "once-through" basis. This water is chlorinated continuously for algae and slime control.

Elizabethtown - Approximately 400,000 gpd is purchased from the municipal supply. Roughly 50% of this total volume is used to produce steam.

7. Sewerage:

Domestic wastes are handled by twelve (12) septic tanks which are cleaned out periodically by an outside contractor.

8. Processes:

1) Organic Area: The processes for the manufacture of miscellaneous organic intermediates and agricultural products are rather complex and confidential.

2) Strontium Area: The methods for the manufacture of strontium nitrate and strontium carbonate are given in Kirk-Othmer's Encyclopedia of Chemical Technology, Volume 13.

3) Hydrochloric Area: The process for the manufacture of hydrochloric acid and its by-product - salt cake - is the well known Mannheim furnace process.

4) Amine Area: Strictly a dilution with water process.

5) Central Area: The manufacture of sodium thiosulfate is by a well known commercial process listed in the Encyclopedia of Chemical Technology, Volume 14. Basically the reactants include soda ash, sulfur dioxide and sulfur.

Aluminum chloride solutions are prepared from hydrochloric acid and hydrated alumina, similar to the method in Encyclopedia of Chemical Technology, Volume 2, second addition.

Aluminum sulfate is manufactured from the reaction of bauxite with sulfuric acid as basically described in Encyclopedia of Chemical Technology, Volume 2, second addition.

6) Sulfamic Area: The manufacture of sulfamic acid is by a process basically described in the Encyclopedia of Chemical Technology, Volume 13. The processes and formulations for the associate products are confidential.

7) Silicate Area: The processes for the production of glass and various grades of sodium silicate solutions are the common commercial ones with slight modifications. (sand + alkali salts).

8) CP Reagent Area: Purification processes where the technical grade commodities are upgraded to reagent grade quality.

9) CSA - So3 Area: The manufacture of chlorosulfonic acid basically is the method described in the Encyclopedia of Chemical Technology, Volume 5 (union of sulfur trioxide and dry hydrogen chloride gas).

Sulfur trioxide is produced by the distillation or stripping of the excess sulfur trioxide in oleum as mentioned in Encyclopedia of Chemical Technology, Volume 13.

10) Sulfuric Area: Various strengths of sulfuric acid are produced by the Contact process described in detail in the Encyclopedia of Chemical Technology, Volume 13.

## WATER POLLUTION ABATEMENT PROGRAM

### 9. Waste Loadings:

Waste loadings, as supplied by the company, are based on raw material yield evaluations - not flow. It was felt that data presented in this manner were more representative since the product line at the Grasselli plant changes frequently, and because no accurate flow figures exist.

Total Wastes (lbs/day) - Jan 1-July 31, 1965

| Days/210 days | Acid as $CaCO_3$ | $NH_4$-N Org-N | $NO_2$-N $NO_3$-N | Red Salts | Misc Org | Phenol |
|---|---|---|---|---|---|---|
| 190 | 22,800 | 390 | 520 | - | 50 | - |
| 100-140 | 6,300 | 680 | 20 | 2230 | 1720 | - |
| 60-90 | 1,700 | 10 | - | - | - | 2500 |
| 18-40 | 12,800 | 1330 | - | - | 1770 | - |

### 10. Waste Treatment:

The majority of the acidic wastes are neutralized either at their point source or in neutralizing pits or boxes. A portable neutralization unit is utilized to handle the acidic washings from tank cars, tank trucks or other equipment.

Several settling ponds (40 to 50 feet in diameter by 12 feet in depth) are located strategically on the plant. These ponds are cleaned periodically by schedule. The organic area also has a collecting tank (approximately 7 feet in diameter and 6 feet in height) which acts as a settling basin and catch tank for any slug of waste inadvertently discharged.

## FMC Corporation, Inorganic Chemicals Division

## Carteret, N. J.

1. Organization:

The subject plant is located at 500 Roosevelt Rd., Carteret, N.J., adjacent to the Arthur Kill. A manufacturing plant was established at this location in 1899 to produce inorganic phosphates. About 1914, the production of baking powders was added to the operations at this location. In 1942, the production of phosphoric acid by combustion of phosphorus was started. Previously the acid had been produced by the wet process.

Main offices for the Inorganic Chemicals Division are in New York City.

2. Products:

The principal products are a full line of sodium and potassium phosphates and phosphoric acid. A minor amount of baking powder and barium nitrate is also produced.

3. Raw Materials:

Principal raw materials are phosphorous, caustic soda, soda ash and caustic potash. Some additives for dry mixing with baking powder are purchased. Small amounts of nitric acid and barium carbonate are used to produce barium nitrate.

4. Operations:

Major production units operate 168 hours per week, while minor ones operate five days per week. Barium nitrate production is on approximately a two-day-a-week basis.

5. Employees:

Present employment is 250 persons.

6. Water Supply:

Approximately 145 mgy (million gallons per year) of fresh water are purchased from the Middlesex Water Company. About 97 mgy of these are used in processing and are primarily lost by vaporization while the balance of 48 mgy are used for boiler feedwater. Approximately 4.4 mgy are recirculated as condensate.

Cooling water is pumped from the Arthur Kill at an annual rate of 660 mgy.

7. Sewerage:

All domestic wastes are discharged to the Carteret sewer system.

Cooling water is returned to the Arthur Kill through the North Outfall and the South Outfall.

## WASTE CONTROL

8. Phosphoric Acid:

The phosphoric acid unit is cooled by vaporization of fresh water to steam and with recirculating condensate. The condensate is cooled with sea water in a liquid-liquid heat exchanger.

9. Inorganic Phosphate Reactions:

All reactions are heated to speed reaction rate and maintain high concentrations in solution. Heating is accomplished with steam coils.

10. Drying and Cooling:

In the south plant where the products are dried, cooled and dry mixed, the outside of the product coolers are cooled with sea water.

11. Closed Loop:

From the oxidation of phosphorous, considerable excess heat is available for the evaporation of waste process liquids so that the material may be returned to process.

12. Housekeeping:

Spilled materials and floor sweeping are scavenged and disposed of off the premises.

## SOURCES OF WASTES

13. Barometric Condenser:

There is one barometric condenser with an entrainment separator in the barium nitrate production unit of a patented design which prevents carryover into the salt water side.

14. Yard Drainage:

Run off from the ground surface and roofs discharges to the Arthur Kill and is not normally sampled during waste surveys.

15. **Waste Survey:**

At the request of Interstate Sanitation Commission and the New Jersey State Dept. of Health, the waste cooling water returning to Arthur Kill was sampled between May 18 and June 4, 1965. The total rate of pumping was 5.76 mgd. The vent flow (by-passed to the Arthur Kill at the intake) was 0.14 mgd. Two of three discharges were sampled and composited in proportion to daily rate of flow to form the sample for the North Outfall. These two flows were from the phosphoric acid unit and the potassium phosphate unit. Wastewater discharges from barium nitrate production were not included in this sampling program, The wastewater from this operation is discharged as one of three outlets comprising the North Outfall. The South Outfall at 0.29 mgd consisted of waste cooling water from the drying operations. The phosphorous was reported as $P_4$. The results are tabulated and summarized in Table I of this memorandum.

The intake and waste waters were also analyzed for BOD and the results are presented in Table II of this memorandum.

16. **Future Monitoring:**

Management reports that a discharge of 300 to 500 pounds per day of $P_4$ is good practice and the monitoring of the two outfalls is being established as a continuing practice.

## TABLE I

### Sewer Losses

| Date | INTAKE | | | NORTH OUTFALL(Net) | | | SOUTH OUTFALL(Net) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow mgd | P conc. PPM | Vent Flow mgd | Flow mgd | P Conc. PPM | P load lbs/day | Flow mgd | P Conc. PPM | P load lbs/day |
| 5/18/65 | 5.76 | 2 | 0.14 | 5.33 | 75 | 3336 | 0.29 | 24 | 58 |
| 5/19 | | 2 | | | 29 | 1290 | | 81 | 195 |
| 5/20 | | 0 | | | 57 | 2535 | | 310 | 745 |
| 5/21 | | 0 | | | 33 | 1468 | | 21 | 50 |
| 5/22 | | 0 | | | 35 | 1557 | | 154 | 370 |
| 5/23 | | 3 | | | 107 | 4760 | | 32 | 77 |
| 5/24 | | 0 | | | 22 | 978 | | 20 | 48 |
| 5/25 | | 0 | | | 51 | 2268 | | 37 | 89 |
| 5/26 | | 0 | | | 32 | 1423 | | 16 | 38 |
| 5/27 | | 0 | | | 41 | 1824 | | 17 | 41 |
| 5/28 | | 0 | | | 20 | 889 | | 37 | 89 |
| 6/2 | | 0 | | | 22 | 978 | | 24 | 58 |
| 6/3 | | 1 | | | 47 | 2090 | | 53 | 127 |
| 6/4 | | 2 | | | 13 | 578 | | 13 | 31 |
| Avg. | | | | | 42 | 1855 | | 60 | 144 |

## TABLE II

## BOD - Mg/Liter

| Date | In | North | South |
|---|---|---|---|
| 5/18 | 16 | 16 | 15 |
| 5/19 | 16 | 15 | 14 |
| 5/20 | 17 | 10 | 10 |
| 5/21 | 18 | 14 | 15 |
| 5/22 | 14 | 14 | 10 |
| 5/23 | 18 | 11 | 10 |
| 5/24 | 17 | 16 | 7 |
| 5/25 | 11 | 42 | 8 |
| 5/26 | 10 | 11 | 8 |
| 5/27 | 12 | 9 | 6 |
| 5/28 | 17 | 13 | 5 |
| 6/2 | 9 | 17 | 5 |
| 6/3 | 9 | 12 | 6 |
| 6/4 | 8 | 7 | 4 |
| Avg. | 13.7 | 14.8 | 8.8 |

## Reichhold Chemicals Inc.

## Elizabeth, New Jersey

In October 1965, Reichhold Chemicals Inc. connected the remainder of their waste discharges into the sewer system of Elizabeth, N.J. Prior to this date, approximately 500,000 gpd, or 50 per cent of the plant's wastes flow was discharged directly to the Arthur Kill. These wastes were from the Phthalic Anhydride, and the Maleic Anhydride processes.

## Reichhold Chemicals, Inc.

## Carteret, New Jersey

### 1. Organization:

This particular unit of Reichhold Chemicals, Inc., was established about 1960 on 42 acres of land purchased from U.S. Metals Refining Co. It is located at the end of Middlesex Avenue in Carteret, past the U.S. Metals Refining Co. Among the other Reichhold Chemicals, Inc. plants, is one located in Elizabeth, N.J.

### 2. Products:

The Carteret plant produces phenolic moulding compound and melamine.

### 3. Raw Materials:

The raw materials for the moulding compound are:

Phenolic resins (from other RCI plants) received and processed as a solid material
Wood flour
Pigments, colorents and lubricants

The raw materials for the melamine are:

Dicyandiamide
Anhydrous ammonia
Alcohols

### 4. Operations:

Melamine is produced 168 hours per week and moulding compound is manufactured 120 to 144 hours per week.

### 5. Employees:

Employment is furnished for 80 persons.

### 6. Water Supply:

All water is supplied by the Middlesex Water Company at a rate of approximately 3 million gallons per month.

### 7. Sewerage:

Domestic sewage is treated in septic tanks and absorption fields.

Boiler blowdown ( 100% make-up) is discharged to a ditch between the RCI plant and Koppers' Forest Products Division.

Waste water discharges to a ditch to the Arthur Kill.

8. Outline of Processes:

Phenolic resins and wood flour are ground and blended with pigments, lubricants, etc., heated and granulated to produce the phenolic moulding compound.

The raw materials for melamine are combined in a direct reaction without any side reactions.

## WASTE CONTROL

9. Phenolic Compounding:

There is an extensive vacuum cleaning system in this area for recovery of particulate matter which is returned to process. The floor is swept and the dust collected by the vacuum system. The floors may be occasionally washed with a hose.

10. Settling Tanks:

Waste waters from the phenolic compounding and from the melamine production are settled in underground catch basins before discharge to the respective sewers.

## SOURCES OF WASTE

11. Phenolics and Heat:

The extrusion presses for compounding the phenolic moulding material are jacketed and the temperature is controlled by a single pass flow of water tempered with steam. This amounts to about one-half of all water purchased for this plant. There is also a small amount of floor washings. These total wastes are discharged through an opening in a manhole to an open ditch and drains to the Arthur Kill. Some of it is absorbed in the land fill which is slag from U.S. Metals Refining Company.

12. Cooling Tower:

It is reported that there is not any overflow from the cooling tower associated with the production of melamine.

13. Melamine Waste Water:

There is a small flow of settled water from the production of melamine which is normally absorbed by the slag in the yard.

At the time of this meeting some jackets were being experimentally cooled with running water which, combined with other waste water from this area, joined the flow from the phenolic compounding area and drained to the Arthur Kill. If this cooling is beneficial, arrangements will be made to reduce the volume of water discharged.

## American Cyanamid Company, Warners Plant

## Linden, New Jersey

### 1. Organization:

The Warners Plant of the Industrial Chemicals Division, American Cyanamid Company, is located at the eastern edge of Linden, New Jersey, at Tremley Point. Operations began in this area in 1916. At the present time approximately 690 people are employed.

The Company's property - 30 acres at this location - is bounded on the south by the Rahway River and on the east by the Arthur Kill. Warehousing facilities are maintained along the western portion of the Jersey Turnpike in Linden, New Jersey - 32 acres. The company also maintains 115 acres of settling lagoons for alum sludges on the southern shore of the Rahway River.

### 2. Products:

The following items are produced by this facility:

Acid - $H_2SO_4$
Alum
Mining chemicals - flotation promoters
Surface active agents
Fumigants
Pesticides
Insecticides
Paper resin
Acrylamide
Rubber chemicals
Intermediates
Soil stabilizers

The product listed above are broad categories, as the company produces over 200 different type products.

### 3. Raw Materials:

Raw materials used include:

Bausite - production of alum
Sulfur - $H_2SO_4$
Acrylonitrile - Acrylamide
Phosphorus pentasulfide - pesticides, insecticides and mining chemicals
Organic alcohols.

The above mentioned raw materials are those most frequently used. Because of the number of end products there are a variety of smaller quantities of raw materials.

4. Capacity and Operations:

The actual production capacity of the plant and operating schedules are considered confidential information by American Cyanamid.

Processing of two of the main products are described below:

Acid manufacturing

Molten sulfur is heated in a furnace and mixed with air; $SO_2$ is produced; catalytic reaction changes $SO_2$ to $SO_3$; $SO_3$ is absorbed into $H_2O$. Amount of absorption depends upon acid concentration desired.

Alum

Bauxite is digested with $H_2SO_4$ to extract the $Al_2O_3$; liquor is decanted off; muds are washed with $H_2O$ to recover $Al_2O_3$ and then pumped to lagoon area. Products are either sold as liquid or dry.

5. Water Supply:

Two sources of water supply are available, namely Arthur Kill and the municipal supply from Elizabethtown. Fresh water, consumed at the rate of 800 gpm, or 1.15 mgd, is used for sanitary purposes, equipment cleaning, boiler feed and for manufacturing purposes.

Salt water from the Arthur Kill, consumed at a rate of 28 mgd is used on a once through basis for cooling only. All cooling systems are jacketed with the water pressure higher than the product pressure.

6. Sewage:

All sanitary wastes from the facility are handled by septic tank systems and leaching fields. These installations were approved by the Linden, New Jersey Board of Health.

## WASTE TREATMENT

7. Industrial Wastes:

At the present time there are eight outfalls---four cooling water and four combination cooling and process water discharging directly into either the Arthur Kill or Rahway River. The four cooling water lines are not monitored by the company. Barometric condensors are used, in the mining chemicals, pesticide and Acrylamide production areas, and therefore, some carryover of the product line in the cooling water can be expected.

The four combined outfalls, are sampled on a composite basis for either an 8 or 24 hour period, once a week. Results of this sampling for the period 5/14/64 to 2/11/65, are given below:

| Outfall | Type Wastes | Average Loading BOD lb. per day | Flow (mgd) |
|---|---|---|---|
| 1 | Pesticides<br>Surfactants<br>Insecticide<br>Rubber chemicals<br>Mining chemicals | 3,210 | 2 to 4 |
| 5 | Acrylamide<br>Misc. Production<br>Paper resin | 3,284 | 1.0 |
| 6 | Pesticides | 176 | 0.4 |
| 8 | Mining Chemicals<br>Xanthate | 1,299 | 1.0 |

At the present time, with one exception - oxidation of wastes from monomethylamine process, - all wastes are discharged to the receiving waters without "end-of-sewer" treatment.

Information on the temperature and DO levels of the Arthur Kill in the vicinity of the discharges - from the period 5/14/64 to 2/18/65 - have been supplied by the American Cyanamid Company.

## WATER POLLUTION ABATEMENT PROGRAM

At the present time, the Warners Plant of the American Cyanamid Company is under formal orders from the New Jersey State Department of Health to abate pollution and discharge no more than 2,000 to 2,500 pounds per day of BOD.

Back in 1960, the plant was discharging approximately 10,000 pounds of BOD per day. The plant since this time, has undergone appreciable growth, and if it were not for inplant process design changes which kept the figure at 10,000 pounds, it is estimated that the loading would have reached as high as 16,000 pounds per day.

Within the past year, the company has initiated major process changes in its Acrylamide production. These changes have resulted in the recovery of by-products for the company and have also reduced the BOD loading from this operation. When modifications are completed it is anticipated that the load from this operation will be approximately 500 pounds of BOD per day, where previously loads averaged 2,500 pounds per day.

## 8. Future Pollution Program:

By the end of 1966, the company will have completed a major program designed to reduce its BOD load from approximately 7,000 pounds per day to 2,000 - 2,500 pounds. The program provides for the barging of aqueous effluents - high concentration low volume - to sea, 110 miles, for disposal. Permits therefore have been obtained from the U.S. Corps of Engineers which were granted after clearance by all Federal and State Agencies concerned.

On-shore collection and storage facilities will be installed at the plant site. The effluent will be loaded and barged to sea by a barging contractor under a contract of affreightment which is currently being negotiated. The effluents to be barged essentially fall into three classifications:

1. Organic phosphate pesticides.
2. Mercaptans.
3. Other phosphorus - sulfur compounds.

The total aqueous effluents to be barged will be 8.2 million gallons per year. The percentage of organic contaminants in these effluents follows:

| | |
|---|---|
| 1.5% | ethyl mercaptan |
| 0.5% | 0,0-diethyl S-(ethylthiomethyl) phosphorodithioate |
| 0.5% | 0,0-dimethylphosphorodithioate of diethylmercaptosuccinate |
| 0.5% | 0,0-diethyl 0-p-nitrophenylphosphorothioate |
| 0.05% | 0,0-dimethyl S-(methoxycarbonylmethyl) phosphorodithioate |
| 4.0% | toluene |
| 0.05% | monomethylamine |
| 0.05% | benzene |
| 0.5% | sodium dioctyl sulfosuccinate (surfactant) |
| 0.5% | sodium 0,0-dimethylphosphorodithioate |

## American Cyanamid Company

## Woodbridge, New Jersey

1. **Products:**

There are about 77 products made in this plant. These are classified under one of the following categories:

Stearates )
Specialty chemicals ) Company officials consider quantity
Catalysts ) information confidential
Mining chemicals )

2. **Raw Materials:**

There are approximately 130 raw materials. The major ones are:

Petroleum waxes )
Vegetable & mineral base oils )
Fatty acids ) Company officials consider
Acids & alkalis ) quantity information confidential
Acrylonitrile )
Oxides of iron )
Sodium chloride )

3. **Capacity:**

The plant is presently operating somewhat below maximum capacity. The plant's future growth is expected to be of such a nature that its effluent will remain approximately at its current level.

4. **Operations:**

This installation operates essentially 24 hours per day, 7 days per week. About half of the employees are on day shifts and the remainder cover night shifts.

5. **Water Supply:**

About ninety five percent of the water used, or approximately 90,000 gpd, is obtained from a well on the plant property. The remainder - approximately 5,000 gpd - is purchased from the Middlesex Water Company.

## SOURCES OF WASTES

| Product Line | Estimated Flow(gpd) | Source | Constituents after treatment |
|---|---|---|---|
| 1. Sulfonated Oils | 1000 | Process + cooling | 400 ppm Total ($Na_2SO_4$, NaCl, glycerol) |
| 2. Wax Sizes | 250 | Cooling + floor washing | Trace - wax, gum, Dowicides, Dispersing Agent |
| 3. Chrome acetate | - | Floor washing | Trace - chrome salt |
| 4. Drum dryer | 14,000 | Floor washing | 40 ppm Total-polyacrylates, $MgSO_4$, $ZnSO_4$ |
| 5. Stearates | 25,000 | Filtrate | 1580 ppm Total-$Cacl_2$,NaCl |
| 6. HI-3 catalyst | 100 | Floor washing | Trace - $(NH_4)_2Cr_2O_7$, $Cr_2O_3$, $Fe_2O_3$ |
| 7. FM-2 catalyst | - | Electrode cooling | None |
| 8. Lab | 4,000 | | |
| 9. Aluminum acetate | 150 | | Trace - $CaSO_4$ Al. acetate |
| 10. Scrubber | 3,500 | | 500 ppm $NH_3$ |
| 11. Sanitary | 2,000 | | |
| 12. Cooling water | 40,000 | | |
| 13. Softener | 5,000 | | 250 ppm NaCl |
| | 95,000 | | |

BOD results mainly from glycerol, dispersing agents, and acetates. No barometric condensers are used.

## WASTE CONTROL

All sanitary and process wastes are discharged to a two-celled lagoon with a detention time of about one week. The blending section (approximately 50,000 gal. capacity) allows for chemical flocculators to be added if necessary. The settling section has a capacity of approximately 560,000 gallons. About once every three years sludge is removed and used for land fill. The lagoon discharges to Woodbridge Creek at a point about 3 miles from the Arthur Kill.

Effluent samples, collected once a week, have the following average results:

pH - 7
Total solids - 2800 ppm
Volatile solids - 250 ppm
Suspended solids - 40 ppm
Turbidity - 120 JCU
5-day BOD - 80 ppm

Analyses of the effluent are sent to the New Jersey State Department of Health on a monthly basis.

## General Aniline and Film Corporation, Dyestuff & Chemical Division

## Linden, New Jersey

### 1. Organization:

The Linden Plant of the Dyestuff & Chemical Division, General Aniline & Film Corporation, was obtained by the corporation in 1928. The plant occupies approximately 145 acres in southeastern Linden, N.J., in an industrial area adjacent to the Arthur Kill. Approximately 1600 people are employed at this facility.

A map supplied by the company shows the layout of all production and service buildings.

### 2. Products:

This plant produces a wide range of organic and inorganic chemicals including dyes, pigments, surface active agents and a wide variety of chemical specialities.

### 3. Raw Materials, Capacity, Operations:

A simplified discussion of the raw materials, processes and finished products can be made by outlining the two continuous plants, each separately, and then the older section of the plant:

#### Chlor-Alkali Plant

This plant uses ordinary salt water and electricity to produce chlorine, sodium hydroxide, muriatic acid, sodium hypochlorite and hydrogen. The plant has a design capacity of 235 tons of chlorine per day. Allocated to this plant is 12.0% of the fresh water or about 325,000 gpd; and 10.4% of the salt water or about 1.15 mgd. About 45,000 gpd of the fresh water is included in the final products so that the total effluent from this operation is 1.43 mgd. (Water use figures based on 50 ton/day plant - replaced in 1962 with 235 ton/day facility).

Discharge from the plant is at two points, as shown on the company supplied map. The first stream, which is processed through the waste treatment plant, amounts to about 954,000 gpd. The second stream discharges directly to the final effluent and is about 454,000 gpd of uncontaminated salt cooling water and 22,000 gpd containing about 0.06% chlorine. The plant operates continuously around the clock on a seven day week.

## Ethylene Oxide Plant

Air and ethylene gas are reacted to form ethylene oxide. In a second step, ethylene oxide and water are reacted to make ethylene glycols. The plant has a design capacity of 60 million pounds of ethylene oxide per year, and 35 million pounds of ethylene glycols. This plant uses only fresh water and consumes an average of 15.1% or about 410,000 gpd. About 215,000 gpd is the make-up in the cooling water and in steam losses. This leaves 195,000 gpd discharging to two places as shown on the company supply exhibit. About 193,000 gpd to streams No. 9 and No. 10, and 2,000 gpd to the main discharge system through No. 5. This plant operates continuously, around the clock, on a seven day week.

## Remaining Plant

The remainder of the plant, exclusive of service buildings, is comprised of seven production buildings designed for multi-purpose chemical manufacture. The heart of each of these buildings is a series of reaction vessels known as kettles, which in most cases occupy the entire second floor. The kettles are not interconnected in any fixed fashion, but may be connected in any variety of patterns, depending on the end product or products of a given time. Other areas of each building are devoted to auxiliary equipment required for these reactors, such as, tanks for bulk storage of raw materials and of intermediates, filters and filter presses, mixers, tubs, dryers, grinders and mills, packaging devices, etc. These auxiliaries may be interconnected and cross-connected with the other equipment to establish the desired flow pattern. Decisions as to flow may be determined by equipment availability, equipment capability or capacity, material of construction of equipment, or by product or intermediate to be produced.

Although these seven production areas are similarly laid out in most respects, each area is usually devoted to a given type of product. This assignment is established from a production control point of view or due to the availability of certain specific auxiliaries. As production or sales requirements vary, changes can be and are made with respect to assignments of specific areas.

The list of basically different chemical or physical final products produced in these areas, at any one time, would number about 2,000. Many of these final products are compounded or blended to specific customer requirements, giving a product breakdown of possibly three times that number.

The raw materials used in quantity for these productions number over 500. Some of the major bulk raw materials are:

Raw Material

1. Sulfuric Acid
2. Acetic Acid
3. Nitric Acid

Raw Material (Cont't)

4. Sodium Chloride
5. Aluminum Chloride
6. Sodium Carbonate
7. Sodium Bicarbonate
8. Sodium Sulfate
9. Sodium Hydrosulfide
10. Sodium Acid Sulfite
11. Potassium Hydroxide Flake
12. Sodium Hydroxide Flake
13. Urea

Identification of even these basic raw materials with any specific final products would be impossible since, for example, Sulfuric Acid is handled in 5 different concentrations, supplied to 6 different production areas and is used in the production of more than 300 products.

Most of these final products are evolved through the plant in a step-wise procedure, that is, by producing from two to sixteen "pre-step" products or intermediates before the final product is obtained. These pre-steps are frequently combined with other pre-steps or raw materials, resulting in "families" of related final products known as "trees". Pre-steps, intermediates and final products in this type of chemical work are produced in a series of batches (e.g. 3 batches per day for two weeks) known as "campaigns". The production of a given campaign at a given level or pre-step is drummed and stored until a campaign of the next level of production can be scheduled. In order to provide for a desired final warehouse stock level of a given final product requires, in many cases, planning and initiating production of the first pre-step or level for that product as much as 16 months in advance of requirements. The over-all production of finished goods for a given year as well as the production of important intermediates and pre-steps, known as the "annual production schedule" is determined on the basis of sales anticipation and, also, to maintain a predetermined "minimum inventory standard" (quantity) in the various warehouses. This annual production schedule is up-dated quarterly and monthly area production requirements are established from this. These requirements are transmitted to the respective production areas and area production schedules are developed. Raw materials are then obtained based on the anticipated production. From here on the scheduling of the actual production is handled on a day to day basis depending upon: -

1. Equipment availability (of the required size, capability and material of construction).

2. The immediate urgency for this particular material as compared to others on the production schedule.

3. The availability of pre-step materials for the production.

It may be concluded that it is not possible to maintain a fixed operational schedule but, like managing a baseball team, decisions are made as the immediate situation dictates and in keeping with an overall goal or purpose.

The active processes available at any one time for the production of the pre-steps, intermediates and final products number over 4,000 with probably a thousand more under research or development, awaiting development of sales interest from customers or being revised and improved. Attempts have been made to list the active processes at a given time, break them down for a specific type of information and to correlate this information. These attempts, due to the changes and variables mentioned, have proven fruitless.

Against this background, obtaining significant information with respect to process water requirements, cooling water requirements or effluent evolved by taking the requirements of the individual processes in production at any one time and attempting to arrive at a sum total has proven equally fruitless. The process water requirements for any one process are usually specific, however the time cycles of the processes vary widely, the time cycle of a given process is not fixed and, therefore, the number of batches produced per day or week are not constant. The cooling water requirements vary with the above as well as depend upon the season of the year and the rate of reaction of the process so that no correlation based upon the number of processes in production at a given time may be obtained.

The effluent evolved is the result of the combined variables and, as has been previously stated, the effluent from each building is not segregated but rather combined in a common sump before discharge. This combining of effluents, however, has a particular advantage, in that, although the greater number of processes have an acid effluent, many result in a highly alkaline effluent. The initial combining of effluents provides a long period for mixing and equalization before reaching the waste treatment plant, resulting in a reduction in treatment required and in operational costs.

## 4. Water Supply:

The Linden plant utilizes both fresh and brackish water for its operations.

### Fresh Water

Fresh water is obtained from the Elizabethtown Water Company and enters the plant at two points as shown on the company supplied drawing. The high monthly consumption for 1961 expressed an average gallons per day was 3.1 million gallons and the low 2.21 million gallons. The total consumption for 1961 was 1.01 billion gallons.

Usage of water by the various buildings and areas (with the exception of the ethylene oxide plant which has a separate meter) is determined monthly on an allocation basis. More precise determinations were found to serve no particular purpose. The total allocations by areas for 1961 are shown in the table.

Water Allocations for 1961

| Production | Fresh Water | Salt Water |
|---|---|---|
| Dyes, Dye Intermediates and Pigments | 31.6% | 27.3% |
| Chemical Intermediates and Specialties | 10.8 | 29.6 |
| Surfactants and Chemical Specialties | 5.8 | 18.0 |
| Chemical Specialties and Iron Carbonyl | 2.5 | 5.4 |
| Chlor-Alkali Plant | 12.0 | 10.4 |
| Ethylene Oxide Plant (Metered) | 15.1 | -- |
| Total | 77.8% | 90.7% |
| **Service** | | |
| Service and Utility Bldgs. | 5.1% | 9.3% |
| Steam and Ice | 17.1 | -- |
| Total | 22.2% | 9.3% |

Fresh water is used for process water, equipment and area cleaning, cooling, manufacture of steam and ice, laboratories and drinking and sanitary purposes. When the original plant was built no provision was included for the conservation of fresh water. As alterations are made, on all recent and new construction, provision have been made to recirculate fresh cooling water and to collect and reuse steam condensate. This action is necessarily revolutionary since repiping of old areas of the plant for this purpose, is economically out of the question.

Salt Water

Salt water is obtained from the Arthur Kill. Since most of the water is used for cooling purposes, the consumption is considerably higher during the summer months. The high monthly consumption for 1961 expressed in average gallons per day was 15.15 mg and the low was 8.4 mg. The total annual consumption for 1961 was 4.02 billion gallons.

The salt water usage by the various buildings and areas is determined on an allocation basis similar to that used for fresh water. The total allocations by areas for 1961 are shown in the previous table.

Salt water is used mainly for cooling but also for cleaning, where practical, and for fire protection. As the shift continues toward fresh water recirculating cooling systems, the salt water consumption as well as fresh water consumption should begin to decrease.

## WATER POLLUTION ABATEMENT PROGRAM

### 5. Waste Treatment Facilities

The Linden plant is built on filled marshland and all of the major buildings are constructed on piles. The mean elevation of the plant is approximately 10 feet above mean low tide, such that at high tide brackish water is 3 to 5 feet below ground level. For this reason all utilities, where practical are carried on overhead treatles. Before the advent of plastic sewer pipe, construction and maintenance of an underground sewer system was either impractical or impossible. Thus the discharge from all but the most recent buildings is collected under the buildings in a common sump and conveyed by wooden sheet-piled culverts to a wooden sheet-piled collection trench system. A schematic drawing of the culverts and the trench system is shown on a company supplied drawing.

Streams or discharges which are not presently connected to the system have been intentionally diverted, since they are not considered contaminated, and also to reduce the total load on the waste treatment facilities.

For more than 12 years, the effluent from the Linden plant has been treated to neutralize the general acid condition of the waste, to skim any oils or other floating materials discharged, and to settle solids. This treatment was revised and improved continually to meet increased requirements and restrictions and to compensate for changes in effluent quality. The expanded Chlor-Alkali plant made necessary the relocation of these treatment facilities. Since it was generally agreed that the old facilities were operating at the limit of their capabilities, the management of the corporation decided to include in the relocation adequate provision for treatment under the current regulations and restrictions, as well as to provide excess capacity and room for expansion.

Construction of the new waste treatment plant was started in the spring of 1961 and completed during March of 1962. Following the usual minor start-up problems the plant was fully onstream by June 1, 1962.

The plant, which provides equalization, solids settling, oil and floating material skimming, and neutralization reflects an expenditure of about $500,000, including the new outfall. Operating expenses are estimated at about $200,000 per year with an additional $20,000-$30,000 spent each year for research and development work. Drawings supplied by the company show a plot plan and a flow sheet of the treatment facility. The capacities indicated in the drawing were obtained from the mean and maximum water throughput of the Linden plant. The neutralization plant is designed to handle the maximum throughput under the most acid condition anticipated and automatically control the outfall pH to 5.0

Since there is no retention of water in the manufacturing plant for more than a few minutes, or at the most a few hours, the total effluent is considered to be the total water consumption less 5-10% due to evaporation and steam losses, plus surface drainage during rains. By this reasoning, the maximum average daily effluent for a month is estimated to be about 17 to 18 mgd. Separate studies made in the past indicate that the mean daily requirement during the summer months was 18 mg and the maximum daily consumption was 26.3 mg.

The above discussion of the operations at this facility is a summation of a more detailed report sent to Federal Water Pollution Control Administration by the General Aniline & Film Corporation. Included in this report are detailed drawings showing layout of the plant facilities and the waste treatment facilities. Also included, are test results of the effluent collected both by the New Jersey State Health Department and by the company.

## Armour Agricultural Chemical Company

## Carteret, New Jersey

### 1. Organization:

This plant of Armour Agricultural Chemical Company, occupying approximately 7.5 acres, is located on the eastern edge of Carteret, New Jersey. The facility, which began operation in 1909, employs approximately 45 to 150 people, depending upon the season of the year. The Company's corporate office is located in Atlanta, Georgia. The parent company is Armour & Company, Chicago.

### 2. Products:

This plant of Armour Agricultural Chemical Company produces over 50 different types of commercial and specialty fertilizers. Approximately 80 percent of its output is for commercial purposes. The only other product is superphosphate (quantity not used internally for production is sold).

### 3. Raw Materials:

Raw materials used include:

Phosphate rock - 20,000 tons per year
Potash - 4,000 tons per year
Ammonium sulfate - 2,500 tons per year
Triple superphosphate - 2,000 tons per year
Limestone - 2,400 tons per year
Sulfuric acid
Liquid nitrogen
Magnesium sulfate
Potassium chloride

All raw materials are delivered by tank truck or by barge. The limestone, phosphate rock and triple superphosphate are delivered approximately four times per year by barge.

### 4. Capacity:

This facility has the capacity for producing 44,000 tons per year of fertilizer and 20,000 tons per year of superphosphate. Fifteen years ago production was almost double the above mentioned values. The reasons for the decrease are geographical location of the plant, and changes in fertilizer utilization.

5. Operations:

Essentially, the bulk of the operations at this facility consist of blending various quantities of nitrogen, phosphorous and potash to form desired fertilizers. This batch operation, having a cycle time of approximately three minutes, produces 1.25 tons of fertilizer, which is stored until such time as bagging is desired.

The only other operation at this plant is the manufacture of superphosphate, which is used internally and also sold. This process involves unloading $PO_4$ rock from a barge; grinding it to a dust; and mixing it with $H_2SO_4$ to give superphosphate.

Operations at this plant, because of the nature of the use of fertilizers, is highly seasonal. During March through May the work force triples. The normal operating day is 16 hours; however, during the winter months this goes down to eight hours. This plant operates on a five day per week basis.

Prior to November, 1965, this plant also produced sulfuric acid. This operation has been completely discontinued and it is almost certain that the manufacturing facilities will be dismantled within the next few months.

6. Water Supply:

Two sources of water supply are available, namely the Arthur Kill and the municipal system from the Middlesex Water Company. Fresh water, consumed at a rate of 12,000 cubic feet per month or 3,000 gpd, is used for drinking and sanitary purposes; air-conditioning; and in a scrubber system in the superphosphate department. When the sulfuric acid plant was in operation, total fresh water consumption was equal to approximately 3.4 million gallons per year or 9,300 gpd.

Salt water from the Arthur Kill can be used at the rate of 110,000 gpd. This water, which was used for cooling in the sulfuric acid operations, is presently on a standby basis.

7. Sewage:

During the past year the company has conducted dye tests and examined several drawings to determine how their sanitary wastes are handled. As of this date, no knowledge exists on this subject. The only thing known for sure, however, is that it does not connect to the city sewer system.

8. Principal Processes:

The principal processes at this plant are blending.

9. **Waste Treatment Sources:**

When the acid manufacturing facility was in operation, effluent, which included cooling and process water, was discharged to the Arthur Kill through a small tributary stream. An analysis of this discharge, performed routinely by the company, is given in the table.

EFFLUENT ANALYSIS FOR $H_2SO_4$ PLANT

| | Plant Shut Down Kill Pump Operating | | Plant Operation Kill Pump Running | | | |
|---|---|---|---|---|---|---|
| | 10/26/65 | | 11/31/65 | | 11/19/65 | |
| | In | Out | In | Out | In | Out |
| Suspended Solids | 18 | 36 | 7 | 11 | 46.0 | 5.0 |
| pH | 6.6 | 2.2 | 6.6 | 2.5 | 6.3 | 2.7 |
| Temp °F | 62 | 60 | 44 | 40 | | |
| Total N mg/l | 4.4 | 10.5 | 3.9 | 9.7 | 3.1 | 7.8 |
| Nitrite N mg/l | | 1.2 | 0.6 | 1.3 | 0.0 | 0.7 |
| Nitrate N mg/l | 0.8 | 0.2 | 1.5 | 0.6 | 0.8 | 0.2 |
| Free N mg/l | 4.4 | 9.3 | 3.5 | 8.4 | 3.1 | 7.0 |
| Total $P_2O_5$ mg/l | 3.0 | 20.0 | 3.2 | 24.0 | 2.8 | 34.0 |
| COD mg/l | 144.0 | 152.0 | 72.0 | 160.0 | 160.0 | 192.0 |

Reportedly, the area near the sulfuric acid plant and Arthur Kill once contained nitric acid manufacturing facilities. It is claimed by company officials that the low pH shown in the October 26, 1965 analysis is due to leaching from the surrounding areas. No samples of this effluent have ever been taken by the State Health Department or the Interstate Sanitation Commission.

With the shutting down of the sulfuric acid plant, it appears that the major source of pollution from this installation has been eliminated. The only other waste being discharged by this facility, and this is going to a lime-lined-lagoon area and not directly to the Kill, is water used for scrubbing in the superphosphate department. This diked lagoon is susceptible to tidal flooding, and therefore, is a potential source of pollution.

Another potential source of pollution is runoff from the plant property. The production areas and buildings are heavily coated with dust, and therefore, during rain periods runoff would be discharged to the Arthur Kill.

## Sinclair-Koppers Company, Inc.

## Port Reading, New Jersey

### 1. Organization:

The Sinclair-Koppers Company, Inc., Port Reading Plant is located in Port Reading, New Jersey, approximately 1/2 mile inland of the Arthur Kill.

The plant was constructed in 1958 and began operations early in 1959. Employment is approximately 200 persons.

This plant was formerly known as Koppers Company, Inc., Plastics Division Plant. The name was changed to Sinclair-Koppers Company, Inc. early in 1965. Home office for the plant remains at the Koppers Building in Pittsburgh, Pennsylvania.

### 2. Products:

This plant produces one product, high density polyethylene. The final product is in the form of 1/8" diameter pellets.

### 3. Raw Materials:

The raw material for this plant is ethylene which is delivered by pipeline from the Humble Oil Company, Bayway Refinery. Additional materials used in the processes are catalysts and carrier hydrocarbons.

### 4. Capacity:

The plant has been rated at 30 million pounds per year of product by several published magazines in the field.

### 5. Operations:

The Port Reading Plant of Sinclair-Koppers Company, Inc., produces high density of polyethylene by the **Ziegler** process. According to extracts from the patents, the process is essentially as follows: The catalyst is $TiCl_4$ in the presence of aluminum triordiakls. Along with ethylene gas, alcohol is fed to the reactor in order to terminate the polymer. Aliphatic hydrocarbons, such as hexane, kerosene, isooctane, or cyclohexane, may be used as the reaction medium. A slurry of 20-30% polymer is produced in the reactor. The polymer is separated by centrifuging and extraction of the cake with $C_4$ or higher alcohols. The polymer is recovered from the solvent and dried to produce a fluffy polymer which is formed into small cubes. The waste process water from this plant has been in contact with the solvent alcohol.

The plant operates on a 24-hour per day, 7-day per week basis.

### 6. Water Supply:

All water used is purchased from the Middlesex Water Company. A 1962 survey indicated consumption as 530,000 gpd. Since that time some reduction has occurred and plant consumption now is 450,000 gpd. Of this approximately 75,000 gpd is used in the process itself. Process water in 1962 was reported to be 100,000 gpd. The majority of water use is for cooling tower purposes. A normal high volume water user, the steam distillation process, is not utilized in this plant's adaptation of the Ziegler process.

7. Sewerage:

Sanitary wastes flow to a septic tank 16' long by 8' wide by 10' deep. Septic tank effluent is discharged to a ditch which flows to the Arthur Kill.

Process water flows to a main sump consisting of two bays 24' long, 6' wide and 5' water depth. From the sump the water is pumped to the same ditch utilized for the septic tank effluent. The point of discharge of process water in the ditch is approximately 1/2 mile from the Arthur Kill. Additional waste water emanates from the cooling tower blow-down which discharges into the septic tank outfall. Plant storage tanks are diked so as to prevent discharge of material in the event of spills.

8. Solid Wastes Disposal:

All solid waste is removed by truck.

## WASTES CHARACTERISTICS

The waste sources from an operation such as that of the Sinclair-Koppers Company, Port Reading Plant, can be divided into three categories: the sanitary wastes; contaminants in waste process water; and additives utilized in the cooling towers which may be discharged in the cooling tower blow-down water. The untreated process water from the Ziegler process would be expected to contain alcohol as well as traces of catalyst residue. The untreated cooling tower blow-down water will include those chemicals added for slime control and other required treatment for satisfactory coolant operations.

9. Waste Sources and Treatment:

Alcohol is recovered from the process water as an in-plant process. Used process water is conducted to a sump described previously. The sump has a baffled inlet and outlet with discharge occurring by flow under the outlet baffle so as to skim off any hydrocarbons. The effluent pH is checked two times per shift. Caustic neutralization is used to maintain pH 6 to 8. A heavy mat of hydrocarbon with the appearance of wax forms on the surface of the sump and is removed by hand once or twice per year. The outlet end of the sump discharges to a wet well with a float actuated pump discharge.

Visual observation of the sump effluent indicates a relatively turbid material with high suspended solids. According to Mr. Tallon this is mainly aluminum hydroxide. Water in the cooling tower system is treated with chrome for slime control. In addition, an annual application of a proprietary chemical from Dearborn Chemical is applied to the tower. No treatment is provided the discharge of blow-down water from the tower.

10. Analytical Results:

Limited analyses are available of the waste water from this plant. On May 8, 1962 the Interstate Sanitation Commission performed analysis of a grab sample at the sump with the following results:

BOD - 80 mg/l

Settleable Solids - 422 mg/l

Total Suspended Solids - 518 mg/l

On July 24, 1962 the Koppers Company performed several analyses with results as follows:

Composite Sample at Sump

BOD - 670 mg/l

Settleable Solids - 413 mg/l

Total Suspended Solids - 442 mg/l

COD - 955 mg/l

pH - 9.7 mg/l

Composite at mouth of ditch with outgoing tide

BOD - 60 mg/l

Settleable Solids - 64 mg/l

Suspended Solids - 82 mg/l

pH - 9.0 mg/l

Grab sample at mouth of ditch at low tide

BOD - 80 mg/l

Settleable Solids - 68 mg/l

Suspended Solids - 76 mg/l

COD - 40 mg/l

pH - 7.6 mg/l

As noted previously, water consumption at the time of the above analyses amounted to 530,000 gpd. The sump discharge volume was estimated as 1/5 of this total or 100,000 gpd.

## WATER POLLUTION ABATEMENT PROGRAM

The Sinclair-Koppers Company has a continuing effort in waste control and water pollution abatement. The company has engaged the local firm of Goodman, Alger & Scott to prepare cost estimates for connection of the septic tank and process water discharge to the Woodbridge Sewer System for treatment by the municipality.

## Union Carbide Corporation, Plastics Division

## Bound Brook, N. J.

### 1. Organization:

The Plastics Division of Union Carbide Corporation is located on the northern edge of Bound Brook, N.J. along the Raritan River. The facility, which employs approximately 2700 to 2800 employees, covers an area of 150 acres.

The Bound Brook location is the Division's main office for manufacturing, research, development, general engineering, accounting, electronic data processing, and distribution. The Fibers and Fabrics Division, also located at Bound Brook, is operated by the Plastics Division.

### 2. Products:

This facility produces over 500 distinct synthetic resins and plastics; however, they can be grouped into four major categories:

Phenolic Resins
Polystyrene
Polyethylene
Vinyls

Chemicals, such as formaldahyde, are manufactured at this location for use within the plant. Approximately one half to two thirds of the product line is made to order; the remainder is "stock" business.

### 3. Raw Materials:

Major raw materials used include:

*Phenol
Styrene
Resins - vinyl, polyethylene
Solvents - alcohols, toluene (type purchased depends on end product)

*Phenol will be produced at this plant within the next 8 months. This will not increase plant capacity, but rather eliminate the purchasing of the raw material - phenol. The Cumene Process is to be used. (Allied Chemical patent).

### 4. Capacity:

This plant of Union Carbide has a total capacity of 350 to 400 million lbs per year. Exact capacities on individual products are not available.

5. Operations:

Essentially there are four separate operations at this plant.

Phenolic resins - condensation reaction; batch operation. Formaldehyde-produced by reaction of methanol and air - plus phenolic compound yields desired phenolic resin. Ratio of raw products determines type of resin produced.

Polystyrene - polymerization reaction; continuous operation

Vinyl & Polyethylene - physical combination; batch operation

The facility operates 24 hours per day, 7 days per week, 52 weeks per year. There is no noticeable seasonal fluctuation in operation.

6. Water Supply:

Three sources of water supply are available, namely, Elizabethtown Water Company, private wells, and Delaware and Raritan Canal.

Elizabethtown - approximately one million cu. ft. per month, or 249,000 gpd, is purchased from the municipal system. This water is used for potable and sanitary needs, and for special processing where a high quality water is needed.

Private Wells - used only in summer - May through September - on a once through basis for jacketed cooling. Eleven wells - average depth 300 feet - on property; however, only using six. Temperature of water 68°F reduces refrigeration needs. Well yield is 400,000 gpd. Extremely hard - 30 grains - water.

Jacketed cooling water is used mostly in the phenolic and polystyrene sections. It is used in other areas for blenders, and compounding equipment. After use---once through---water discharged directly through storm sewer to Raritan River.

Delaware & Raritan Canal - average withdrawal - 1.3 mgd; maximum - 1.8 mgd. Used for general plant use - boiler feed, cooling tower makeup. Prior to use, water is chlorinated and settled.

7. Cooling Water:

Three cooling water systems, supplied by the Delaware & Raritan Canal, serve the facility:

| | |
|---|---|
| System B - phenolic, styrene: | 12,000 gpm |
| System C - vinyl, polyethylene: | 11,000 gpm |
| System D - research, development: | 9,000 gpm |

Makeup water to these systems is approximately 5 percent.

8. **Sewerage:**

All wastes, industrial, domestic and roof drainage, in the wet processing areas -- phenolic production -- go to the Middlesex County Sewerage Authority. All sanitary wastes in the dry processing areas also go to MCSA. Roof drainage and runoff in these areas go to the storm sewers. MCSA receives daily approximately 800,000 gallons from the Union Carbide complex.

There are presently three storm sewers - conveying cooling and runoff waters - discharging to the Raritan River. Average Flow figures, as supplied by Union Carbide are given below:

| Sewer | Flow-gpd |
|---|---|
| North | 100,000 |
| Center | 350,000 |
| South | 350,000 |

9. **Analytical Data:**

The three storm sewers discharging to the Raritan River are sampled routinely by both the company and MCSA. Results of these samplings are shown in the tables which follow:

**Union Carbide** - Sample period 1/12/65 - 2/8/66

| Parameter | | Sewer | | |
|---|---|---|---|---|
| | | North | Central | South |
| BOD (mg/l) | Max | 685 | 240 | 90 |
| | Min | 2 | 3 | 2 |
| | Avg | 50 | 51 | 14 |
| | No. Samples | 21 | 22 | 22 |
| Phenol (mg/l) | Max | 0.71 | 36.2 | 38.4 |
| | Min | 0.01 | 0.05 | 0.01 |
| | Avg | 0.2 | 4.9 | 2.8 |
| | No Samples | 9 | 22 | 22 |

**MCSA** - BOD, COD sampled 1/4/66; phenol samples June 1965

| Sewer | Flow mgd | BOD mg/l | COD mg/l | phenol mg/l |
|---|---|---|---|---|
| North | .04 | 11.9 | 50 | 0.02 |
| South | .09 | 25.8 | 400 | 0.04 |
| Center | .490 | 20.7 | 58 | 0.13 |

## National Lead Company, Titanium Division

## South Amboy, N. J.

### 1. Organization:

The National Lead Company's Titanium Division occupies approximately 580 acres in the Borough of Sayreville, N. J. The facility is located on the south shore of the Raritan River just above the Garden State Parkway Bridge. There are over 1900 employees engaged at this location in production, maintenance, process control, engineering and research.

### 2. Products:

Titanium dioxide--an inert non-toxic white pigment--in some 33 different grades is the principal product of this plant. This pigment is used by paint, paper, plastic, ceramic and drug industries.

### 3. Raw Materials:

Titanium dioxide is manufactured from Ilmenite ore which is received by rail or deep water vessel.

### 4. Capacity:

The capacity of this facility is considered confidential.

### 5. Operations:

Ilmenite ore is received in sandlike consistency containing 40 to 60 percent titanium and the balance is largely iron with silica and some traces of various elements. The ore is reacted in concentrated sulfuric acid. The iron-titanium sulfate solution is clarified to remove inert materials which are collected for disposal at sea via barge.

The clarified solution is crystallized and filtered to remove most of the iron as ferrous sulfate. The ferrous sulfate or copperas is either sold in dry or wet state or repulped with spent acid for disposal at sea via barge.

The clarified titanium sulfate solution is hydrolyzed. The resultant white titanium hydrate is washed to remove the spent acid. This acid is disposed of at sea via barge. The titanium hydrate is then calcined and milled to develop final properties as required for the various grades of titanium dioxide.

### 6. Water Supply:

Two sources of water are available; namely, the Raritan River and the Duhurnal supply - industry operated (National Lead, DuPont, Hercules). Approximately 50 mgd of water are required for the chemical processing of raw ore into pigment--44 mgd from the river and 6 mgd from the fresh water source.

7. Sewerage:

All sanitary wastes from this installation either go directly to the Middlesex County Sewerage Authority or to septic tank systems on the plant property.

8. Principal Processes:

The principal unit processes used for the manufacture of titanium dioxide pigment are clarification, filtration, crystallization, settling, conditioning, roller and hammer milling and drying. A flow diagram showing the inter-relationship of these processes has been supplied by the company.

9. Waste Treatment:

The initial plant installation at South Amboy, N.J., included a system for recovery of spent acid and iron sulfate. This system was unable to economically provide the degree of control needed to meet increasing standards for stream quality. A study of alternate methods developed a proposal for barging the wastes to sea for disposal. After several years of investigation into the effects of such disposal an application was filed through regulatory agencies and approval was granted for disposal at sea. This method was put into operation in 1948 and is still the primary means of waste disposal for the company.

Since 1948, a program has been in effect to improve waste control procedures at the plant and to keep these wastes out of the effluents going to the river. These efforts have required:

1. Construction of a series of settling basins for clarification of one effluent stream.
2. Collection of certain waste streams and neutralization before transmission to the Middlesex County Sewerage Authority for disposal.
3. Monitoring of effluent streams--pH only--to the river to provide for further refinement in the control of plant wastes.

Most of the water obtained from the Raritan River and used for processing is returned to the river. Liquid wastes from the plant operations are segregated from this stream, and depending upon their characteristics, are either handled by facilities of the Middlesex County Sewerage Authority, the company's barge disposal system, or the company's sedimentation facilities.

Wastes which are not recovered are discharged to the Raritan River. These wastes are the result of leaks or spills occasioned by malfunction of equipment and failure of controls.

The company has not undertaken steps to measure the exact quantities of waste materials discharged in the plant effluent, as it would require expensive sampling and flow measurement. National Lead feels that such a program is not warranted considering the nature and quantity of emissions.

Company supplied data indicate that the discharge of waste materials amounts to approximately 5,000 pounds of sulfuric acid and 3,000 pounds of iron sulfate on an annual daily average.

## WATER POLLUTION ABATEMENT PROGRAM

Capital expenditures to date for control of emissions to the Raritan River exceed $7.75 million. Current direct operating costs are $1.4 million annually. Approximately $100,000 is spent each year for control measurement, and engineering studies for further improvements.

## American Cyanamid Company

## Bound Brook, N. J.

### 1. Organization:

The Bound Brook plant, located in Bridgewater Township, is presently the second largest of Cyanamid's 103 United States and foreign manufacturing facilities. As headquarters of the company's Organic Chemicals Division, the location is the administrative, research and sales center for eight plants and four commercial departments.

In the fall of 1915 the firm, then known as the Calco Chemical Company, began producing aniline and beta naphthol in three small buildings on an 18-acre site in Bridgewater, adjoining Bound Brook. This small aniline facility was one of the first in the country. As the plant grew, its products multiplied. By 1920, spurred on by successful research, and wartime demand, its products had increased from the original two to some 50 dyes and intermediates.

In early 1929, the plant was manufacturing more than 400 different chemical compounds, which included a full line of dyes, a host of intermediates, rubber processing chemicals and a variety of pharmaceuticals. By 1940 the number of products had increased to 500, and 2,500 people were at work in the plant's operations.

When war came in the early '40s every resource was quickly committed to the needs of the military. Output soared to new levels in all product lines, employment climbed to the all time peak of 4,500 and the Bound Brook facility became the world's largest maker of life-saving sulfa drugs.

The present complex, located on 575 acres along the north bank of the Raritan River, employs approximately 3,000 people. Manufacturing operations are carried out in 150 buildings on a site of 150 acres.

### 2. Products:

Product lines consist essentially of the following:

Dyes
Rubber Chemicals
Elastomers
Textile Chemicals
Intermediates
Pigments
Pharmaceuticals

3. Raw Materials:

Information on this subject is considered confidential by the company.

4. Capacity - Operations:

Company officials consider information on these subjects confidential.

5. Processes:

Approximately 800 different processes are in use at this plant. Information on individual systems is considered confidential.

6. Water Supply:

Four sources of water, namely, Raritan River, Company owned wells, the Somerville and Bound Brook Water companies are available.

Raritan River Water

Approximately 22.5 mgd of Raritan River water is presently diverted for use within the plant. Actual water needs for current operations at Bound Brook approach 55 mgd. The additional 32 mgd is obtained by recirculating water in towers and ponds.

Water which is diverted from the river goes into a concrete lined flume through a screen which removes floating debris, and then into a chamber in which the suction pipes from four 10" centrifugal pumps are located. The water pumped is discharged into a single 24" pipe and chlorine is added to prevent algae and slime from building up in the pipe. The 24" pipe runs a distance of 1,400 feet into the plant water distribution system.

Part of the water is treated further since the water coming from the river cannot be used "as is". The multi-step treatment includes addition of alum to coagulate solids which are allowed to settle out in one of two large ponds; it receives further chlorination, then passes through sand filters and then through a water softening material such as zeolite. The treated water is used for the steam boilers to produce steam for plant use and for direct use in chemical processes, sanitary facilities, laundry, and ice making. The remainder of the water is used directly for cooling, scrubbing of vapors to prevent air pollution, etc.

All of the water mentioned, after use and re-use, goes to the waste treatment plant.

Well and municipal water

Approximately 2.0 mgd of deep well and municipally supplied water are used at the Bound Brook complex. Somerville and Bound Brook water is used essentially for drinking purposes.

7. Sewerage:

All sanitary wastes are handled by the company's waste treatment facilities.

## POLLUTION ABATEMENT PROGRAM

8. Wastes Treatment:

American Cyanamid began working on its industrial waste problem about 30 years ago in cooperation with the Raritan Valley restoration program of the State Department of Health. In 1940, after careful and successful investigations for development of a suitable treatment process, Cyanamid constructed a $500,000 treatment plant comprising a large lagoon and neutralization system. This system furnished treatment consisting of equalization, neutralization and solids sedimentation. These units have been in service since that time and have been incorporated as the primary treatment portion of the present expanded waste treatment facility.

This early treatment plant was effective in correcting those features of the raw wastes which it was designed to control. In 1949 the company began fundamental investigations of biological methods of waste treatment. In 1950 the State Department of Health issued new and more stringent requirements for waters discharged into the Raritan River.

After nearly a ten-year chemical, biological and engineering project, carried out jointly with consultants and the New Jersey State Department of Health, and an expenditure of over $1,000,000, a reliable activated sludge waste treatment process was developed and approved by the State Department of Health.

Ground was broken for the new facility in March 1957, and the plant was put into operation in May of 1958. The plant cost $4,500,000 and has an annual operating cost of nearly $1,000,000.

The treated used water is returned to the Raritan River at a point about 140' downstream from the raw water pumping station in a quantity equal to, or greater than the intake volume of 22.5 mgd. Approximately 2 mgd of used city water and deep well water, treated at the company's plant, is included in this total discharge.

9. Treatment Plant Operation:

A sump and pumping station deliver all plant wastes to a lagoon. In this basin settleable materials are removed from the waste; however, the main function of the unit is to provide equalization of acid discharges prior to neutralization with lime.

After neutralization, wastes flow through a 60 mg lagoon, which serves a dual treatment function. Materials precipitated from the wastes during neutralization are removed by settling in this basin. In addition, the various colors in the influent intermix. Solids which have accumulated in the basin are periodically removed by dredging. This treatment plant has been operated continuously since 1940.

Flow is transmitted from the 60 mg lagoon through a 48-inch pipeline to a 36-mgd pumping station, which is located in the pipe gallery under the main building. Wastes are then pumped into six aeration tanks which may be operated in several flow patterns. These tanks provide an average detention period which is from three to six times the aeration period normally provided for treatment of municipal sewage.

Six 80-foot diameter sedimentation basins have been provided for removal of the biological sludge, which is returned to the aeration tanks for treatment of the incoming wastes. Effluent is discharged into a small brook leading to the Raritan River. Wastes can be chlorinated in accordance with the requirements of the New Jersey State Department of Health.

Operation of the Bound Brook treatment facility is unique, in as much as it is also designed to provide secondary treatment for up to 5.0 mgd of municipal wastes from the Somerset-Raritan Valley Sewerage Authority. The Authority, serving 45,000 people in Bridgewater, Somerville and Raritan, is presently discharging approximately 3.0 mgd into the American Cyanamid system.

## 10. Analytical Data:

Two tables - "Raritan River Data" and "Pounds BOD Discharged from Wastes Treatment Plant" - have been provided by the company.

### RARITAN RIVER DATA

| 1964 | River Flows - MGD Daily Average | Dissolved Oxygen* Daily Average Above ACCO Dam | Dissolved Oxygen* Daily Average Queens Bridge |
|---|---|---|---|
| January | 1341 | 14.1 | 13.5 |
| February | 694 | 13.3 | 12.7 |
| March | 856 | 12.6 | 12.0 |
| April | 1302 | 11.0 | 10.4 |
| May | 620 | 8.3 | 7.5 |
| June | 203 | 6.8 | 5.2 |
| July | 263 | 5.8 | 5.5 |
| August | 72 | 6.1 | 4.4 |
| September | 70 | 5.3 | 3.1 |
| October | 128 | 8.5 | 7.1 |
| November | 108 | 9.1 | 7.2 |
| December | 502 | 12.7 | 12.1 |

*Based on single daily grab sample taken at approximately 8:00 a.m.

## RARITAN RIVER DATA (Cont'd)

| 1965 | River Flows - MGD<br>Daily Average | Dissolved Oxygen* Daily Average<br>Above ACCO Dam | <br>Queens Bridge |
|---|---|---|---|
| January | 426 | 13.8 | 13.0 |
| February | 1045 | 13.3 | 12.8 |
| March | 785 | 12.3 | 11.7 |
| April | 592 | 11.0 | 10.0 |
| May | 246 | 6.8 | 5.4 |
| June | 89 | 5.4 | 2.6 |
| July | 83 | 4.7 | 3.8 |
| August | 101 | 5.7 | 4.0 |
| September | 111 | 6.0 | 4.2 |
| October | 133 | 7.6 | 6.3 |
| November | 113 | 9.2 | 7.7 |
| December | 149 | 11.7 | 10.3 |

*Based on a single daily grab sample taken at approximately 8:00 a.m.

### POUNDS BOD DISCHARGED FROM

### WASTE TREATMENT PLANT

| Month | Daily Average<br>1964 | <br>1965 |
|---|---|---|
| January | 9,200 | 14,900 |
| February | 13,700 | 18,500 |
| March | 23,000 | 28,000 |
| April | 26,100 | 17,500 |
| May | 20,500 | 15,600 |
| June | 24,100 | 17,800 |
| July | 5,900 | 3,600 |
| August | 8,200 | 6,400 |
| September | 8,500 | 7,500 |
| October | 8,700 | 11,100 |
| November | 8,900 | 10,700 |
| December | 8,400 | 7,600 |

The great reduction in BOD load to the river during the summer months, is claimed by company officials, to be due essentially to higher wastes temperatures - organisms more active, therefore, greater removals - and to changes in production.

## Hatco Chemical Division, W. R. Grace & Co.

## Fords, New Jersey

### 1. Organization:

The Hatco Chemical Division of W.R. Grace Company, is located on the western shore of the Raritan River, approximately one mile upstream from the Victory Bridge. The facility, located on 90 acres in Woodbridge Township, employs approximately 275 people.

### 2. Products:

This plant produces essentially two products: Plasticizers and Phthalic Anhydride. The major plasticizer produced is Dioctylphthalate which accounts for more than 50 percent of the production.

### 3. Raw Materials:

Raw materials include napthalene, which is used in the anhydride process, and organic alcohols, used in plasticizer production. These raw materials are brought in by tank trucks.

### 4. Capacity:

This plant has the capacity to produce approximately 44 million pounds per year of Phthalic Anhydride. Plasticizer production capacity is confidential.

### 5. Operations:

This plant is operated on a seven day per week, 24 hour per day basis. Approximately eighty percent of the employees work on a shift basis. The remaining twenty percent are mainly administrative or maintenance people, working only during the normal eight hour day time shift.

The two principal operations in this plant are as follows:

#### Phthalic Anhydride

Produced by the reaction of napthalene with air at high temperature. There are no waste products from this continuous operation, and therefore, the amount of production is equal to the quantity of raw material - napthalene - used.

### Plasticizers

Most of the Phthalic Anhydride manufactured is used internally for the production of plasticizers. An organic alcohol is combined with the anhydride to form the product. The type of plasticizer produced depends upon the type of organic alcohol used, and as a result, a large variety of alcohols are used.

### 6. Water Supply:

Approximately 2.5 million cubic feet per month of water, or 625,000 gallons per day, is purchased from the Middlesex Water Company. No other sources of water are available.

### 7. Sewerage:

Sanitary wastes from the production facilities are presently handled by seven septic tanks and leaching fields. Sanitary discharges from the executive offices, located in Fords, N.J., are connected to the Municipal sewer system.

### 8. Industrial Wastes:

On October 15, 1965, Hatco signed an agreement with the Middlesex County Sewerage Authority to discharge all of their industrial wastes, with the exception of cooling water, to the Authority. The contributary flow to MCSA is estimated to be 200,000 gpd.

Legal problems, regarding acquisition of right-of-ways, has delayed construction of a sewer line, pre-treatment facilities, and sampling and metering facilities. It is expected, however, that the connection to the MCSA will be completed no later than January 1, 1967. This date will most likely be met, as Hatco is paying the Authority $5,500 per quarter, for interest and amortization. To date, approximately 50 percent of the construction program has been completed.

## Tenneco Chemicals, Inc., Heyden Division

## Fords, New Jersey

### 1. Organization:

Heyden Chemical was a division of the Heyden-Newport Chemical Corporation until 1963 when the company was acquired by Tennessee Gas Transmission. Tenneco maintains executive and operating offices in New York City.

Heyden Chemical, located on 242 acres in Fords, N.J., is presently operated as a division of the parent company. Present plans call for expanding certain facilities and adding new processes sometime during 1966-1967.

### 2. Products:

Organic intermediate chemicals comprising over 200 final products.
Major products include:
Strobane - (chlorinated terpene -- boll weevil control)
Hexamethylene tetramine - used in resins and explosives
Pentaerythritol - used in paint
Maleic anhydride - used in resins
Pthalic anhydride - used in plasticizer (Production stopped 2/65)
Chlorotoluene - used in herbicides and drugs
Benzaldehyde - essential oils, flavorings and insecticides
Hydrochloric acid
Formaldehyde
Benzotrifluoride -- soaps and control of lamprey eel
(A company supplied list gives a further breakdown of products)

### 3. Raw Materials:

- Methanol
- Ammonia
- Formaldehyde
- Acetaldehyde
- Caustics
- Benzene
- Orthozylene
- Chlorine
- Toluene
- Terpenes
- Hydrogen fluoride

### 4. Capacity:

Capacity of the facility is considered confidential.

## 5. Operations:

Production operations at this plant are essentially continuous. The only major batch operation is in the production of terpene derivitives.

Approximately 400 people are employed by this plant, which operates 24 hours per day, 7 days per week, 365 days per year. Fifty percent of the staff works on a shift basis.

## 6. Water Supply:

Two sources of water are available, namely, Middlesex Water Company and a pond (west lagoon), located on plant property, which receive land drainage.

Average monthly plant city water usage is in the area of 56,000,000 gallons/month. Distribution and usage of this water is as follows:

a. Sold in products - 250,000 gallons/month.
b. Cooling tower evaporation - 9,000,000 gallons/month.
c. Process Waste and Sewage - 24,000,000 gallons/month.
d. Ground Drainage - Non returned steam condensate - 8,300,000 gallons/month.
e. Cooling water returned to ponds with pond water -- 13,500,000 gallons/month.
f. Exhaust steam -- 1,000,000 gallons/month.
Total --- 54,000,000 gallons/month.

The pond cooling water pumping rate from the West lagoon, the source of surface cooling water, is 2,000 gallons per minute.

The Fords installation presently has in operation four cooling towers whose effluent (overflow) is being discharged to MCSA. Water evaporation rates calculated from heat loads indicates an average of 210 gallons per minute evaporation rate for the four units.

## 7. Sewerage:

The plant presently has in use ten septic tanks, eight of which are tied into MCSA and two of which discharge into drain fields.

## 8. Processes:

With more than 200 products from the plant, there are many individual processes that are used. They could best be classified as oxidation processes as in the air oxidation of benzene to produce maleic anhydride.

## WASTE SOURCES

a. Hexamethylenetetramine - no process waste water, only cooling water which goes to West Pond.

b. Pentaerythritol - process water to Middlesex County Sewerage Authority. Cooling water goes to West Pond.

c. Maleic anhydride - process water recirculated through cooling tower. Any waste discharged goes to MCSA.

d. Phthalic anhydride - same as c. (no longer in operation)

e. Chlorotoluene - chemical wastes go to MCSA and cooling waters go to West Pond.

f. Benzaldehyde - same as above. (e)

g. Strobane - no process waste and cooling water goes to West Pond.

h. Hydrochloric acid - any process waste goes to MCSA.

i. Formaldehyde - water kept in the product with no cooling water discharged.

j. Two cooling towers overflow at times into the West Pond.

k. Barometric condensers -- cooling in this manner most likely produces a carry-over of the product into the cooling water.

## POLLUTION ABATEMENT PROGRAM

Approximately 0.8 mgd of process wastes are discharged to the Middlesex County Sewerage Authority. Based on water use information, 0.7 mgd is discharged to the Raritan River as cooling water. Flow studies conducted by MCSA, however, indicate this flow averages approximately 1.0 to 1.5 mgd. Tests conducted by MCSA and the Raritan Bay Project indicate that this "cooling water" is carrying a heavy pollutional load. (BOD: 60-2 -- ppm; COD: 120 ppm; phosphate: 1.0 ppm)

Investigations undertaken by the company in 1965 indicate that the flow averages 0.82 mgd; BOD 61-65 mg/l; pH 6.5-7.5; and phosphates .002-0.005 mg/l.

It would appear, based on the above information, that all wastewaters are not being discharged to MCSA. Elimination of the barometric condensers, which is being planned in the hexamethylene tetramine and formaldehyde processes, will probably reduce some of this pollutional load.

## E.I. du Pont de Nemours & Company, Photo Products Division

## Parlin, New Jersey

1. Organization:

This photographic materials plant has been operated at this site since about 1926. The plant is located on Minnisink Avenue, Parlin, New Jersey.

2. Products:

Photographic film is produced for medical purposes, X rays, graphic arts, and motion pictures. Nitrocellulose film was last produced in 1949 and no acetate film was produced in 1964. Present production is a polyester base film known as "Cronar."* A by-product methanol is shipped off the premises for recovery.

3. Raw Materials:

Dimethyl terephthalate (also used in "Dacron"*)
Ethylene glycol
Silver Nitrate
Gelatin
Ammonium Bromide
Potassium chloride
Potassium iodide

Supplies
    Algicide
        Humiclean, 4-5 gpd
        5% Dowicide G
        Possium pentachlorophenol
    Miticide
        Hycol (lysol) 3-5 lbs/day of liquid
    Hydroquinone developers from lab
        5 lbs/day
    Phenolics
        2 lbs/day

4. Capacity:

The production capacity was not reported.

5. Operations:

This plant operated 168 hours per week.

* Reg. Du Pont Trademarks.

6. Employees:

Employment if provided for 2500 people.

7. Water Supply:

Water is obtained from the Duhernal Water Supply, a private water company. Normally 2 mgd are consumed, with a peak demand of 3 mgd.

8. Sewerage:

Domestic sewage is discharged to the Boro of Sayreville and then to the Middlesex County Sewerage Authority.

All plant effluent is discharged to the South River except that used for irrigating the lawns. A ditch about 2 miles long extends from the plant through the Hercules property to the River.

## WASTE SEGREGATION

9. Strong Wastes:

From 5000 to 8000 gallons per week of strong wastes are collected in drums and barged to sea for disposal in the 12-mile dumping ground. Future plans provide for incinerating these wastes at the plant site.

10. Waste Solvents:

Waste solvents are collected and incinerated.

11. Cooling Water:

The remaining wastes, referred to as cooling water, are discharged to the ditch to the South River. Water supplied to the plant averages about 55°F and plant effluent averages about 80°F.

## FUTURE WASTEWATER TREATMENT

12. Treatment of Total Flow:

Tentative plans call for treating all of the plant wastewater in a 5-acre lagoon. The nominal holding time would be 5 days. Floating aerators were being considered. The lagoon would have a wide spillway in order to accommodate yard runoff. The design load would be 1000 lbs of $BOD_5$ per day. The expected reduction would be 80% at 3-day detention.

13. Diversion:

Under an alternate proposal, 150,000 gpd, representing 800 lbs. of $BOD_5$, would be diverted to the sanitary sewer to Sayreville. The balance of the flow with 200 lbs. of $BOD_5$ would be discharged to the proposed lagoons. With this reduced load on the lagoons, the aerators would probably not be required.

## E. I. Du Pont de Nemours & Company, Fabrics & Finishes Department

## Parlin Finishes Plant, Parlin, New Jersey

1. Organization:

Initially a powder plant was constructed at this site about 1890. The facilities were purchased in 1910 by du Pont. Since about 1945 a polymers and plastics plant has been operated at this site. The plant is located on Washington Road in Parlin, New Jersey.

2. Products:

This plant manufactures paint, polymers, and plastic finishes.

3. Raw Materials:

The raw materials are:

Plasticizers
Adhesives
Resins
Alcohols
Esters
Paint Solvents
Vegetable Oils
Water

4. Capacity:

This plant produces about 5 million gallons of pigmented material and 20 million pounds of polymers and plastics per year.

5. Operations:

The plant operates 120 hours per week.

6. Employees:

Employment is provided for 700 people.

7. Water Supply:

Water is obtained from the Duhernal Water Supply, a private water company established in 1938. Water use is 1.5 mgd.

8. Sewerage:

Domestic wastes are discharged to the Boro of Sayreville and Middlesex County Sewerage Authority.

The deep sewer system and the open ditch discharge wastes to the South River.

9. Principal Processes:

Production is divided into two areas:

a. The enamel and clear area, where paint materials are mechanically mixed and containers are filled.

b. The polymers and plastics area, where products are produced by polymerization and esterification.

## WASTE SEGREGATION

Process, cooling, and reaction water wastes are segregated into three collection systems.

10. Deep Sewer System:

Roof drainage and part of the cooling water is collected in the deep sewer system and discharged to the South River. Cooling water is discharged at about 75-80°F, a rise of about 22-27°F. Approximately 120 to 360 pounds of BOD are discharged per day in this sewer.

Water from Hercules Powder is added to this system before discharge to the river.

11. Open Ditch:

The balance of the cooling water and yard drainage is collected in the open ditch and discharged to the South River. The concentration of BOD is reported to be less than 10 mg/l.

12. BOD System:

About 20,000 gallons per day of waste process water is discharged to the BOD system for treatment. This water is from the polymers and plastic area.

## WASTEWATER TREATMENT

13. Separation:

The water collected in the BOD system is treated in a small non-mechanical decanter. Floatable solvents are pumped to a solvent reclaim tank. Water from below the solvent level flows continuously to a pump pit where it is intermittently discharged to a gravity line to the evaporation lagoons. Sludge is removed manually at intervals and stored in drums for incineration.

14. Evaporation Lagoons:

The separated water is discharged to one of three lagoons where seepage and evaporation take place and there is not any overflow.

15. Solvent Reclaiming:

Wash solvent from the enamel and clear area is discharged to two small settling tanks. Sludge is removed from these tanks and drummed for incineration. Settled solvent is transferred to a solvent reclaim tank. This waste solvent is hauled off site to be reclaimed and returned for use.

16. Incineration:

An open pit incineration with provision for forced air is under construction. This will be used for destruction of sludges and solid wastes.

17. Future Waste Disposal:

At the present time negotiations are under way to discharge the waste water from the decanter (item 16) to Boro of Sayreville and Middlesex County Sewerage Authority, replacing the evaporation lagoons.

Hydroscience, Inc., prepared a report on "Pollution Analysis of the South and Lower Raritan Rivers" which considered the deep sewer and open ditch discharges to the South River, excluding the decanted waste water which is presently being discharged to the evaporation lagoons. Decisions to continue discharge of the open ditch and deep sewer to the South River were based on this report.

## Hercules Powder Company

## Sayreville, New Jersey

### 1. Organization:

The Parlin plant of Hercules Powder Company, occupying 800 acres, has been located in Sayreville, N. J. since 1914. The company's main engineering and executive offices are in Wilmington, Delaware.

### 2. Products:

Polyethylene (Hifax) - 50 million pounds per year
Nitro cellulose
Chlorinated rubber (Parlon)
Nitric acid
Acetic acid - 40 million pounds per year
Chlorinated polyethers (Penton)
Esters

### 3. Raw Materials:

a. Polyethylene process: ethylene (piped in); catalysts
b. Nitrocellulose process: nitric acid; cellulose (brought in by rail); sulfuric acid
c. Parlon process (used in paints and printing inks): rubber (brought in by truck); chlorine (brought in by tank car); carbon tetrachloride (recycled)
d. Nitric acid process (used in nitrocellulose production): ammonia (brought in by tank car)
e. Acetic acid process: ethyl alcohol (brought in by rail)

### 4. Capacity:

Production capacity from most of the processes is confidential.

### 5. Operations:

The plant is divided into two sections; plant #1 produces nitrocellulose, Parlon, Penton and nitric acid, plant #2 produces Hifax and acetic acid. The individual processes are covered in Section 11.

The plant employs 1350 people, 50% of which are on shift work 7 days per week, 24 hours per day, 50 weeks per year.

### 6. Water Supply:

The only major source of water is a 5.5 mgd withdrawal from the Duhernal Water System, a joint venture between the DuPont, Hercules and

National Lead Companies. Incoming raw water is adjusted for pH, settled, filtered and chlorinated. Iron is also precipitated out. Six wells are on the premises, however, they are used only approximately 6 days a year.

A large recirculating cooling water system is maintained by the company. Makeup water averages 5 percent.

7. Sewerage:

Sanitary wastes from Plant #2 are discharged to the Middlesex County Sewerage Authority system, while sewage from Plant #1 is discharged to the Borough of Sayreville.

8. Processes:

a Nitrocellulose:
Cellulose is treated with nitric and sulfuric acid, purified and then adjusted for viscosity by heat. It is then dehydrated by pressing, with the water being replaced by alcohol. Water is used for washing, the alcohol recovered, and the water reused for washing. The true dehydration water which is high in BOD, is discharged to the Middlesex County Sewerage Authority.

b. Parlon:
Consists of the chlorination of rubber in carbon tetrachloride. This product is then precipitated and washed with water. The material is then dried. All washwater is discharged to the MCSA.

C, Hifax:
Consists of the polymerization of ethylene in a kerosene-like material, which is later removed. The product is dried and then extruded into pellets. Water is used in steam distillation and cooling. Process waters go to MCSA and some cooling water to a brook which empties into South River.

d. Nitric Acid:
Water is removed to concentrate the acid. This water is neutralized and discharged to a sewer which empties into the South River, a tributary of the Raritan River.

## POLLUTION ABATEMENT

9. Waste Sources:

30" chemical sewer - discharges to South River

Line carries approximately 3.3 mgd of wastes - 3.0 mgd is washwater from nitrocellulose process. BOD averages 35-40 ppm. Analysis of this discharge is given at end of report.

### Number 1 Brook

No direct discharge, possible leakage from lagoon areas. DuPont drainage plus small discharges also in brook. MCSA data shows flow - .87 mgd; BOD - 7.0; DO - 8.7; pH - 8.1.

### Number 2 Brook - discharges to South River

Approximately 363 gpm of cooling water from the Parlon process is discharged to this brook.

Studies conducted by both MCSA and the Raritan Bay Project indicate that flow in this stream is approximately 5.5 mgd. Hercules' flow contribution is about 10%.

Analysis of the stream, before it enters, and after it leaves Hercules' property is given below:

| Location | BOD | COD | Total Solids | Total Fixed Solids | Total Sus Solids | Total FSS | Phenols | |
|---|---|---|---|---|---|---|---|---|
| Before | 44 | 121 | 171 | 93 | 13 | 2 | .04 | .08 |
| After | 37 | 131 | 219 | 127 | 37 | 37 | .04 | .03 |

All results, reported in mg/l, are averages of eight hour composites collected over a 24 hour period. The second phenol column is based on an average of three grab samples collected over a 24 hour period.

### Number 3 Brook - discharges to South River

Receives approximately 290 gpm of cooling water from Hifax and Power House. MCSA data indicates BOD - 0.7; DO - 6.4; pH - 6.2; flow - .32 mgd.

### Process Wastes

Approximately 900,000 gpd of process wastes are discharged to the Middlesex County Sewerage Authority.

### 10. Waste Treatment:

Wastes being discharged to the 30" sewer are first treated in the company's private neutralization plant which was approved by the State of New Jersey in 1948. Reports on operation are sent to the State once a month. (See end of report.) Treatment consists of neutralization with lime, aeration, settling, cooling and reaeration. During peak periods, some of the incoming flow is diverted to a storage lagoon.

Sludge, which is composed of calcium sulfate and lime is removed every three months and used for landfill. **Effluent analysis, supplied by Hercules, follow:**

SAMPLE ANALYSES OF NO. 1 CHEMICAL SEWER (30" DIA.)

| Date | pH (a) | D.O. (a) | B.O.D (b) | Temp. °C. (b) | Remarks (a) |
|---|---|---|---|---|---|
| 1/22/64 | 5.7 | 8.61 | 34 | | 8-hr. composite |
| 2/12/64 | 5.7 | 7.35 | 44 | 24° | 8 " " |
| 3/19/64 | 9.0 | 6.59 | 43 | 20.5° | 8 " " |
| 4/22/64 | 7.8 | 7.30 | 36 | 26.5° | 8 " " |
| 5/20/64 | 6.2 | 3.33 | 71 | | 8 " " |
| 5/27/64 | 7.1 | 5.83 | 28 | | 8 " " |
| 6/23/64 | 3.2 | 2.31 | 55<br>64 | 29° | 8 " " |
| 7/22/64 | 5.1 | 6.68 | 30 | | 8 " " |
| 8/19/64 | 8.6 | 7.04 | 40 | 27° | 8 " " |
| 8/20/64 | 6.8 | 6.80 | 29 | | 24 " " |
| 9/16/64 | 7.0 | 6.64 | 38 | | 8 " " |
| 10/29/64 | 6.9 | 5.50 | 28 | 25° | 8 " " |
| 11/24/64 | 9.0 | 6.00 | 45 | 22° | 8 " " |
| 12/ 8/64 | 8.6 | 6.69 | 51 | 18° | 8 " " |
| 1/12/65 | 8.4 | 6.41 | 39 | | 24 " " |
| 1/21/65 | 8.2 | 6.70 | 37 | | 8 " " |

(a) Sampled at inlet to spray lagoons.

(b) Sampled discharge of spray lagoons.

## SPRAY LAGOONS' EFFLUENT ANALYSES

| Date | pH | B.O.D. mg/l | Temp. °C | D.O. mg/l | Remarks |
|---|---|---|---|---|---|
| 1/28/65 | 8.6 | 40 | | | 8-hr. grab composite |
| 2/ 2/65 | 7.3 | 40 | 12° | 8.80 | 8 " " " |
| 3/ 3/65 | 6.9 | 33 | | | 8 " " " |
| 4/29/65 | 6.7 | 48 | | | 24 " cont. " |
| 5/12/65 | 7.7 | 35 | | | 8 " grab " |
| 5/24/65 | 7.3 | 30 | | | 24 " cont. " |
| 5/26/65 | 5.1 | 40 | 36° | 5.20 | 24 " " " |
| 5/27/65 | 7.1 | 64 | | | 24 " " " |
| 5/28/65 | 6.3 | 38 | | | 24 " " " |
| 5/29/65 | 7.2 | 43 | | | 24 " " " |
| 5/31/65 | 6.8 | 25 | | | 24 " " " |
| 6/ 1/65 | 6.7 | 18 | | | 24 " " " |
| 6/ 2/65 | 6.8 | 53 | | | 20 " " " |
| 6/ 3/65 | 6.5 | 42 | | | 24 " " " |
| 6/ 4/65 | 6.6 | 36 | | | 24 " " " |
| 6/ 5/65 | 6.9 | 33 | | | 24 " " " |
| 6/ 6/65 | 5.5 | 34 | | | 24 " " " |
| 6/ 7/65 | 6.5 | 54 | | | 24 " " " |
| 6/ 8/65 | 7.0 | 52 | | | 24 " " " |
| 6/ 9/65 | 6.7 | 41 | | | 24 " " " |
| 6/10/65 | 6.9 | 48 | | | 24 " " " |
| 6/11/65 | 4.7 | 36 | | | 24 " " " |
| 6/15/65 | 8.0 | 53 | | | 24 " " " |
| 6/22/65 | 6.5 | 34 | | | 24 " " " |

## SPRAY LAGOONS' EFFLUENT ANALYSES

| Date | pH | B.O.D. mg/l | Remarks |
|---|---|---|---|
| 6/23/65 | 7.3 | 25 | 24-hr. cont. composite |
| 6/24/65 | 7.5 | 27 | 24 " " " |
| 6/25/65 | 7.2 | 46 | 24 " " " |
| 6/29/65 | 7.3 | 26 | 24 " " " |
| 6/30/65 ) | 7.4 | 24 | 9:30 A.M.-1:30 P.M. cont. composite |
| 6/30/65 ) | 7.2 | 22 | 1:30 P.M.-5:30 P.M. cont. composite |
| 6/30/65-7/1/65) | 7.1 | 14 | 5:30 P.M.-7:30 A.M. cont. composite |
| 7/ 1/65 | 7.2 | 20 | 24-hr. cont. composite |
| 7/20/65 | 7.6 | 34 | 24 " " " |
| 7/21/65 | 8.1 | 40 | 24 " " " |
| 7/22/65 | 7.2 | 28 | 24 " " " |
| 7/28/65 | 7.2 | 20 | 24 " " " |
| 7/29/65 | 7.5 | 24 | 24 " " " |
| 8/ 3/65 | 7.0 | 39 | 24 " " " |
| 8/ 4/65 | 7.2 | 29 | 24 " " " |
| 8/ 5/65 | 6.9 | 37 | 24 " " " |
| 8/19/65 | 7.5 | 30 | 24 " " " |
| 8/24/65 | 7.1 | 22 | 24 " " " |
| 8/25/65 | 6.9 | 23 | 24 " " " |
| 8/30/65 | 7.0 | 35 | 24 " " " |

## SPRAY LAGOONS' EFFLUENT ANALYSES

| Date | pH | B.O.D. mg/l | Remarks |
|---|---|---|---|
| 9/ 1/65 | 7.1 | 29 | 24-hr. cont. composite |
| 9/ 9/65 | 7.1 | 28 | 24 " " " |
| 9/14/65 | 7.3 | 34 | 6 hourly grabs " |
| 9/15/65 | 7.3 | 77 | 7 " " " |
| 9/21/65 | 8.0 | 40 | 8 " " " |
| 9/23/65 | 5.2 | 37 | 8 " " " |
| 9/27/65 | 6.8 | 36 | 8 " " " |
| 9/28/65 | 7.2 | 44 | 8 " " " |
| 10/ 5/65 | 8.0 | 31 | 8 " " " |
| 10/ 6/65 | 6.5 | 31 | 8 " " " |
| 10/ 7/65 | 8.1 | 67 | 8 " " " |
| 10/19/65 | 7.8 | 83 | 8 " " " |
| 10/26/65 | 7.4 | 60 | 8 " " " |
| 11/ 3/65 | 7.5 | 39 | 8 " " " |
| 11/ 9/65 | 7.3 | 58 | 6-hr. cont. comp. |
| 11/16/65 | 6.9 | 52 | 6 " " " |
| 11/16/65 | 7.1 | 43 | 8 hourly grabs " |
| 11/17/65 | 7.2 | 33 | 8-hr. cont. comp. |
| 12/ 8/65 | 8.2 | 38 | 8 " " " |

## American Smelting and Refining Company

## Perth Amboy, New Jersey

### 1. Organization:

American Smelting and Refining Company is located on the eastern edge of Perth Amboy, New Jersey, adjacent to the Arthur Kill. The facility occupies a total of 145 acres: 70 for operations and 75 for slag dumping. Approximately 1,400 people, 75 percent of which are on a day shift basis, are employed. The company's main executive and operating offices are located in New York City.

### 2. Products:

The following is a list of finished products and quantities produced:

| | |
|---|---|
| Refined copper (bar, rod, cake) | 13,500 tons per month |
| Brass alloys | 600 tons per month |
| Antimonial alloys and oxides | 175 tons per month |
| Refined gold | 30,000 ounces per month |
| Refined silver | 3,500,000 ounces per month |

### 3. Raw Materials:

Raw materials used include:

| | |
|---|---|
| Copper bullion | 11,000 tons per month |
| Scrap copper and brass | 5,000 tons per month |
| Antimonial crudes | 50 tons per month |
| Precious metal scrap | 40 tons per month |

### 4. Capacity:

Plant capacity is given under the subheading 2. Products

### 5. Operations:

Given below is a flow diagram of all processes at this facility. Each is broken down with the following information: Name and description; raw materials; quantity of cooling and process water (fresh and salt); finished product; location of discharge and sizes of effluent channels or pipes; operation schedule (hours per day, days per month).

## A. Refined Copper

Raw material - copper bullion
scrap copper and brass
↓
melt and cast to anodes
↓
electrolyze anodes

2,000,000 cu. ft. condensate water per month
↓ ⟶ copper slimes
refined electrolytic copper

No effluent channels or pipes.

Water added to compensate for evaporation

Mould cooling water recirculated through cooling towers

## B. Brass Alloys

Raw material - refined copper
" tin
" lead
" zinc
brass
↓
finished product

Melt and cast into special sizes
and shapes of rods and tubes
conforming to rigid chemical
and physical specifications.

Mould cooling water recirculated through cooling tower

No effluent channels or pipes.

Operating 24 hr./day, 30 days/month

## C. Antimony Alloys and Oxides

Raw material - crude antimonial lead alloys
↓
process in steel kettles
at high temperature
↓
finished product

Specification alloys of lead and
antimony and antimony oxide

No water required - salt or fresh

No effluent channels or pipes.

Operating 24 hrs./day, 30 days/month

### D. Refined Gold and Silver

Raw material - copper refinery slimes
precious metal scrap
↓
smelt in furnace to produce metal
↓
cast metal into anodes
↓
electrolyze
↓
finished product

Fresh water - 2,000 cu. ft./month replacement
for evaporation

No effluent channels or pipes.

Operating 24 hrs./day, 22 days/month

### 6. Water Supply:

Two sources of water supply are available, namely Arthur Kill and the municipal supply from the City of Perth Amboy. Fresh water, used at a rate of 3,500,000 cubic feet per month, or approximately 875,000 gallons per day, is used for steam production, sanitary and drinking purposes, and for makeup water in the plant's recirculating cooling water system.

Salt water from the Arthur Kill, used at a rate of 5,000 gpm, or 7.2 mgd, is used mainly for jacketed cooling in condensers and furnaces.

### 7. Sewage:

All sanitary wastes from the facility go to the Perth Amboy sewer system. Process wastes discharged to Perth Amboy amount to 500,000 cubic feet per month, or 124,000 gpd.

### 8. Principal processes:

Refining is the principal process at this facility.

## WATER POLLUTION ABATEMENT PROGRAM

The plant has five sewers, the location of which are shown on a company supplied map, which discharge either directly to the Kill or to small tributaries. The only wastes reportedly being carried by these conduits are cooling waters, condensate waters, and overflow water from the plant s cooling pond. As mentioned previously, all sanitary wastes and processing water goes to the city sewer system.

Analyses have never been performed on these discharges by either the company, Interstate Sanitation Commission, or the New Jersey State Health Department.

## United States Metals Refining Co.

## Carteret, New Jersey

### 1. Organization:

This refinery is a solely owned subsidiary of American Metal Climax and is part of the United States Metals Refining Division of the parent company. The other unit of the division is the Pyron Plant at Niagara Falls, New York, which produces iron powder. This metal refinery was initially established at this location in 1902. The refinery is located on Arthur Kill near Tufts Point at the south edge of Carteret, New Jersey.

### 2. Products:

This metal refinery produces copper: tough pitch, powdered, and oxygen free in various shapes and alloys. Crude zinc oxide and crude nickel sulfate as well as a variety of precious metals are also produced. The production of germanium and germanium oxide has been discontinued.

### 3. Raw Materials:

The two principal raw materials at this refinery are scrap copper and foreign blister. Foreign slimes from copper refineries and jeweler's waste are also purchased. This refinery no longer receives copper sulfide.

### 4. Capacity:

From approximately 15 to 18 thousand tons of scrap materials and contract blister from other smelters per month the refinery produces 15 to 18 thousand tons per month of copper.

### 5. Operations:

The blast furnace and tank house operate at 168 hours per week. The anode and wire bar furnaces operate continuously except for varying periods on weekends. The copper powder operations operate 5 to 6 days per week.

### 6. Employees:

This refinery employs from 1500 to 1700 people.

### 7. Water Supply:

For the past four calendar years the metal refinery has purchased an average of 9,280,000 gallons per day of fresh water from the Middlesex Water Company. Approximately 50.3% is feed water makeup for generation of steam, 4.8% is used for sanitary purposes, and the balance (44.9%) is used for process cooling and heat exchangers and makeup for the cooling ponds of the Bosh water system.

Approximately 36 million gallons per day of brackish water is withdrawn from the Arthur Kill. About 46% is used for shell and tube and barometric condensers in condensing steam at prime movers, 5% is used for jet ejectors producing vacuum for the electrolyte evaporators. 41% is used for other plant processes, cooling by means of shell and tube heat exchangers, and the balance (8%) is used for direct contact cooling.

8. Sewerage:

Three sewage ejectors are used to pump the sanitary sewage into the Carteret sewage system. In case of ejector failure the sanitary sewage is bypassed to the Arthur Kill. These stations are inspected daily and the maximum outage is 24 hours. This occurs perhaps once a month.

All of the waste water and yard drainage are discharged to the Arthur Kill through two outlets, one of which is 30 inches in diameter and the other is 18 inches in diameter.

9. Outline of Process:

All nonferrous scrap which is not classified as No. 1 or No. 2 scrap is sent to the blast furnace for smelting with coke. Black copper is produced in the blast furnace and sent to the converter. The slag from the blast furnace is quenched with salt water and discharged to a slag pit from where it is recovered and sold for shot blasting and aggregate. The gases from the blast furnace are filtered in a bag house and crude zinc oxide is recovered and shipped off the premises for further processing.

In the converter air is blown through the molted black copper and blisters are cast from the converter. Gases from the converter are discharged to an acid spray tower and then go to a Cottrell precipitator before being discharged to the waste gas stack. When this refinery formerly received sulfide ores from Cuba it was desirable to recover the dust from the converter in the Cottrell precipitator. Since the sulfide ores are no longer received the Cottrell precipitator is to be replaced with a bag house dust collector system.

The No. 2 scrap is baled and charged along with locally produced blisters and foreign blisters to the reverbatory furnaces. From these furnaces all copper is cast into anodes.

All the copper, except No. 1 scrap, is electrolytically refined in the tank house.

Cathodes are produced in the tank house. The slimes which accumulate in the bottom of the tanks are sent to the precious metal refinery. Part of the recirculating electrolyte is pumped to the nickel salts plants.

Some of the cathodes are used in the tough pitch casting operations. Here the cathodes are melted with all of the No. 1 scrap and cast into the products ingots, wire bars, and billets.

A second portion of the cathodes are melted in a low frequency induction melting furnace in a reducing atmosphere to produce oxygen free copper which is cast either continuously or in wheel castings to form billets and wire bars.

A third portion of the cathodes are used in plating tanks with greased lead cathodes where the copper ions agglomerate into fine copper powder and fall to the bottom of the tanks. From here the powder is recovered as a slurry and filtered before being further processed by drying in a reducing atmosphere and grinding to form copper powder.

The electrolyte which is sent to the nickel salts plants is evaporated in batch evaporators and sent to crystalizers. The other liquor from the crystalizers which is acid is returned to the tank house. The nickel sulfate crystals are washed in a continuous centrifuge to produce crude nickel sulfate.

The slimes from the tank house and any purchased slimes from other copper refinery operations are processed in the precious metal refinery to produce precious metals in various shapes.

## SOURCES OF WASTE WATER

### 10, Slag Pit:

When the slag is drawn from the blast furnace it is quenched with sea water and discharged to the slag pit which is similar to those used in steel making operations. Surface over-flow from this slag pit is discharged to the 30-inch outlet to the Arthur Kill. Half of the water used for quenching is from the power house condensers.

### 11, Surface Condensers:

Two of the four basic circuits in the tank house are supplied by a direct current generator in power house No. 1, which is driven by a condensing steam turbine. Salt water is used on these surface condensers and returned to the Arthur Kill. About 3 or 4 years ago shot chlorination was installed at the pumping station for all of the salt water supplied from the Arthur Kill and this has reduced the down-time for condenser cleaning by about one-fourth. Chlorine is applied for about 5 minutes once every 8 hours.

### 12. Bosh Water System:

In all of the casting operations except the continuous castings, copper is poured into copper molds which are mounted on a wheel revolving in a horizontal plane. The molds are dressed with a white powder which contains some phosphate. As soon as the copper is poured into the molds water is poured over the copper and the molds to quickly cool them. The castings are removed from the molds and the molds are washed and dressed again ready to form another casting. This water system is known as the Bosh Water System and the water recirculates to two spray cooling ponds or reservoirs. Make-up water for this system is purchased fresh water. Occasionally some of this water is bled off or overflows to the 30-inch diameter outlet to the Arthur Kill. This water may be high in phosphates and copper. About once every 3 years, these reservoirs are cleaned and the residue is returned to the smelter.

13. Nickel Salts Evaporators:

The barometric condensers on these evaporators are cooled with salt water. There is a possibility of carry-over of acid and nickel solutions from these evaporators. The waste waters are frequently checked with methyl orange for an indication of acidic waste. This waste water from the barometric condensers discharges to the Arthur Kill through the 18-inch diameter outlet. The flow is estimated to be about 1.5 million gallons per day.

14. Cutting Oil:

Adjacent to the continuous casting operations it was noticed that metal chips were being discharged to a bin and that the associated cutting oils were being discharged with these chips and drained through the bottom of the bin to the ground surface from where they had been discharging to the storm sewer. These wastes would be discharged through the 18-inch outlet.

15. Lubricating Oil:

Various reciprocating steam driven equipment in this refinery is a potential source of lubricating oils in the condensates from these machines.

16. Demineralizer:

Boiler feed water is treated in a demineralizer at this refinery. Approximately 244 gallons at 60° Baume sulfuric acid is used every two days in regenerating the demineralizer resins.

17. Waste Heat:

Besides the surface condensers previously referred to, many of the furnaces and continuous molds are water cooled by heat exchangers. Most of this cooling is accomplished with salt water which is eventually discharged to the Arthur Kill. On the day of this plant visit the blast furnace and the converter were not operating. The intake water temperature from the Arthur Kill was reported to be 70°F and the outlet temperatures were reported to be 77° on one outlet and 82° on the other outlet.

## WASTE CONTROL

### 18. Tank House:

There is not any gravity drain line from the cellar of the tank house. During rainy periods the cellar may become flooded. If the water is not acid it is pumped to the storm sewer system with two gasoline driven emergency pumps. If the water in the cellar of the tank house is acid, indicating that it may be a spill from the electrolytic tanks, it is pumped to storage tanks in the tank house and used for make-up in the electrolytic tanks.

### 19. Analytical Results:

Samples collected in October 1964 were analyzed by Rutgers University and reported as follows:

| Sample No. | Description | pH | Settleable Solids mg/l | Suspended Solids mg/l | BOD mg/l |
|---|---|---|---|---|---|
| 1 | 30" Inlet | 6.9 | nil | 52 | 4.2 |
| 2 | 30" Outlet | 7.1 | nil | 31 | 3.6 |
| 3 | 18" Inlet | 7.0 | nil | 95 | 3.4 |
| 4 | 18" Outlet | 7.2 | nil | 33 | 3.2 |

## Phelps Dodge Copper Products Corporation

## Elizabeth, New Jersey

### 1. Organization:

The Phelps Dodge Copper Products Corporation Plant is located at the eastern edge of Elizabeth, New Jersey, between the Arthur Kill and the New Jersey Turnpike. This facility presently employs approximately 950 people. The company's main executive and operating offices are located at 300 Park Avenue, New York City.

### 2. Products:

This plant produces essentially copper products in the following form:

Hot rolled rods
Drawn wire, bare and tinned
Flat wire, and bus bar
Stranded wire
Pipe, tube, drawn rods and shapes

### 3. Raw Materials:

Principal raw materials include:

Copper
Tin
Lead
Zinc
Nickel
Non-ferrous metals
Cable seal compound

For the most part, bulk copper bar is brought in by barge. Small quantities of this metal are brought in by truck and rail. All other raw materials are brought in by truck.

### 4. Capacity:

The capacity of this plant is reported to be more than one million pounds of copper per day. The company does not wish to reveal exact capacities.

### 5. Operations:

Basically, this plant operates on a 16 hour, five day per week basis.

Principal operations are outlined below:

Hot Rolling - Wire bars or alloy billets are heated in a suitable furnace to 1,300 - 1,600°F; hot worked by forming rolls to a suitable, useable or marketable copper rod; and then furnished black or cleaned by pickling in a sulfuric acid solution and rinsed. Approximately 2,000 to 3,000 gpm of recirculated fresh cooling water is used in the process. Temperature of the cooling water, depending upon the time of the year, is 90 to 110°F. This process operates on a five day, two shift basis.

Billet Casting - Copper scrap or ingot copper is melted in an induction type furnace. The melt is cast into water cooled molds forming billets. Recirculated fresh water is used for mold cooling at a rate of approximately 1,500 gpm. The temperature varies, depending upon the time of year, from about 90 to 120°F. The casting shop usually operates on a one shift, five day per week basis.

Extrusion Mill - Copper or alloyed billets are heated in a suitable furnace to a temperature of 1,300 - 1,700°F; discharged into the container of a 2,200 ton hydraulic extrusion press, and with a plunger attached to the hydraulic ram, forced through a suitable die for the forming of rod, tube, shell, or any regular or irregular shape that is presently extrudable. Occasionally, a small amount of fresh water is used for quenching the finished product. The finished stock is pickled and cleaned before passing to other operations. The extrusion department usually operates on a one shift, five day per week basis.

Wire Drawing - Clean rod is passed through various types of machines which will cold reduce the cross section through dies. This cold work hardens the wire. In the reducing process it is necessary to anneal (re-soften) the wire when it becomes too hard for further reduction. The wire drawing machines have recirculating systems of drawing compounds which are generally soluble in water. These solutions are recirculated and only changed in cases of emergency. Wire is drawn in many sizes from drawn rod. These products are sold as is, or sent to other departments for further processing. The wire mills operate on a two shift, five day per week basis.

Cold Rolling - Cleaned wire from the wire mill or cleaned rectangles from the extrusion presses are cold reduced by mechanically working them through rolls which reduce their size. This size reduction also increases the hardness, and thus annealing may be needed, depending on the size and temper of the required material. These cold reducing flats are finished in all sizes and are sent out in reels, coils, or cut to straight lengths as required by the customer. The rolling mills operate on a two shift, five day per week basis.

Tinning - This is a process for coating copper wire with tin or tin alloy. It is accomplished by passing the wire through a fluxing tank; through a molten tin bath at approximately 850°F; through a series of wipes to remove the excess tin and form a smooth coat; through cooling water; and then wound on take-up reels.

This material is either shipped direct to the customer or else used elsewhere in the plant for further processing. This department usually operates two shifts, five days per week.

Stranding - This process merely mechanically twists small wire into cable to make the flexible equivalent of solid wire or bus bar. This material is either sold as is, or sent for further processing (insulating) elsewhere. This department normally operates two shifts, five days per week.

Tube and Shape Drawing - Here, material from the extrusion presses is mechanically reduced in size by pulling it through dies on draw benches. This drawing and rolling hardens the material, and depending upon the number of reductions and the physical characteristics required in processing, annealing may be necessary. The finished material from the draw benches may require mechanical straightening and hydrostatic testing. This department would normally operate on a one shift, five day per week basis.

## 6. Water Supply:

Two sources of water are available, namely Arthur Kill and the municipal supply from the city of Elizabeth. Fresh water is used for drinking and sanitary purposes, and for makeup water in recirculating cooling systems used in the hot rolling, billet casting, tinning and cold rolling processes. Small quantities are also occasionally used for quenching in the extrusion mill process. Approximately 3,500 gallons per day of fresh water are used by this installation.

Salt water from the Arthur Kill is used for cooling at a rate of 1.3 mgd. Two separate systems, one with a capacity of 500 gpm and the other 1,000 gpm are in use. The smaller quantity of salt water is pumped through copper coils for cooling the drawing solutions and for minor cooling throughout the plant. This water is used on a once through basis before being discharged to a city sewer system. The remainder of the salt water, used in jacketed condensers for cooling process water in the hot rolling process, is discharged back to the Kill. This again is on a once through basis.

## 7. Sewerage:

Approximately 25 percent of the installation's sanitary wastes go to the city sewer, while the remainder discharge directly to the Arthur Kill through any one of the six sewers.

## 8. Principal Processes:

Principal processes at this plant are hot rolling, billet casting, extrusion, wire drawing, cold rolling, tinning, stranding, and tube and shape drawing.

## 9. Waste Treatment:

This plant of the Phelps Dodge Corporation provides no treatment of its industrial or domestic wastes. At the present time, there are six discharges going directly into the Arthur Kill. Outlined below is a brief description of the discharges into each sewer.

| Discharge | Sewer |
|---|---|
| Hot rolling | 4,5 |
| Billet casting | 6 |
| Extrusion Mill | 6 |
| Wire Drawing | 1,2,3 |
| Cold rolling | 1,2,3 |
| Tinning | 1,2,3 |
| Domestic wastes | 1,2,3,4,5,6 |

## 10. Analytical Results:

At the request of the Interstate Sanitary Commission, the following analyses were performed on the raw discharges:

Analysis, ppm

| Sewer No. | Solids, SS | Oil | Cu. | pH | Flow gpm |
|---|---|---|---|---|---|
| 1 | 119.4 | 48.7 | 0 | 6.8 | 72.4 |
| 2 | 149.3 | 46.5 | 11.8 | 6.9 | 7.1 |
| 3 | 47.7 | 13.0 | 0 | 7.3 | 8.8 |
| 4 | 179.0 | 48.2 | 74.6 | 5.5 | 50.2 |
| 5 | 163.2 | 12.1 | 189.1 | 3.0 | 13.0 |
| 6 | 18.7 | 30.1 | 27.6 | 2.5 | 118.2 |

The above listed analyses were run on composite samples collected over an eight hour period. Flows were measured with a V-notch weir. The flow figures reported are average discharges, and therefore, could be used in computing loads. Only three of these discharge points (4,5,6) are readily accessible for sampling.

## WATER POLLUTION ABATEMENT PROGRAM

On November 5, 1965, Phelps Dodge received a letter from the Inter-State Sanitary Commission, advising them to set up an abatement program on the following basis: Diversion of all sewage to the city sewer system; consideration of a closed circulation system, or some other means to eliminate oil and fine copper solids from being discharged to the Arthur Kill; removal of all floating and settleable solids; and elimination of any precipitant which might form in the Arthur Kill as a direct result of the plant's discharges. The deadline set by I.S.C. for this abatement program is September, 1967.

On the basis of this request the plant has already taken steps to eliminate the discharge of domestic sewage, by moving to another location, their locker and toilet facilities. In addition, all recirculating systems which provide wash and cooling water for the rod mills are being extended and improved. Other inplant modifications designed to reduce quantities of wastes being discharged to the Kill are in the planning stage.

## Nassau Smelting and Refining Company, Inc., Tottenville

## Staten Island, N. Y.

### 1. Organization:

Nassau Smelting and Refining Company, Inc., wholly owned subsidiary of Western Electric Corporation has been at this location since 1905. Nassau became part of Western in 1931.

This Facility, located on approximately 42 acres in Tottenville, Staten Island, employs 654 people, 525 of which are in production work.

2. This plant handles approximately 40 percent of the one million pounds per day of scrap generated by the Bell Telephone system. The finished products of this plant are as follows:

Copper bar
Brass and bronze ingots
Lead pigs
Resin core and wiping solder
Lead sleeving

### 3. Raw Materials:

Raw materials include scrap cable, insulated and non-insulated wire, all types of telephone equipment and apparatus including relays and booths, and all materials that contain non-ferrous metals. Much of this raw material contaminated with wood or plastic. Approximately 400,000 pounds per day is handled at this plant; the remaining 600,000 is handled on a contract basis.

### 4. Capacity:

This plant has a capacity for turning out the following:

| | |
|---|---|
| Copper wire bar | 50 tons per day |
| Brass, bronze & ingots | 50 tons per day |
| Lead pigs | 90 tons per day |
| Solder, resin core | 7,000 pounds per day |
| Bar solder | 12,000 pounds per day |
| Wiping solder | 15,000 pounds per day |
| Lead sleeving | 40,000 pounds per day |

### 5. Operations:

This facility can best be described as a secondary smelting and refining plant because it does not use ores as its source of raw materials.

Essentially, there are five operations: Sorting, stripping, burning and sweating, melting and refining, casting and extrusion.

The plant operates three shifts per day, seven days per week, 52 weeks per year. Approximately 90 percent of the employees work the 16 hour day shift and the remainder the night shift (12 Midnight to 8 A.M.).

The company is presently conducting break-in tests for a new unit designed to produce copper wire directly from copper bar. The equipment developed in Italy, is known as a Properzi Machine. It is anticipated that this unit will be in full production operation by June 1966.

6. Water Supply:

Two sources of water supply are available; namely Arthur Kill and the municipal supply of New York City. Salt water is used as a cooling spray in the plant's rotary hearth furnace at a rate of 250 gpm. This water is used on a once through basis only. The quality of the Arthur Kill water presently satisfies the needs of the plant. No problems have been encountered with corrosion or clogging as a result of these waters being used for cooling.

New York city water, consumed at a rate of 68,000,000 gal./yr., is used for sanitary and drinking purposes, fire protection, spray cooling in the Cottrell unit, and for make-up water in the plant's cooling water systems.

Combined consumption for cooling and operation of the Cottrell unit amounts to 45,000,000 gal./yr. Input to the Cottrell system, which operates 350 day/yr., is 12,250,000 gal./yr. Steam and water loss in this unit amounts to 1,750,000 gal./yr.

The plant's recently installed recirculating water-type cooling system, serving the red metal or copper production shop, has a capacity of 36,000 gpm. Reportedly, this system which is presently operated at 12,000 gpm, has no blowdown or waste. Make-up water is approximately five percent of the system maximum capacity.

It is claimed that much of the water used throughout the plant including the bosh water, a possible pollutant, is collected and put back into the recirculating cooling water system. The quality of this recirculated water is checked monthly by an outside contractor who treats the water with an organic chromate solution to prevent incrustations, slime growths, etc.

The cooling system serving the white metal shop or solder operations also uses city water for make-up. This system, however, has a constant overflow which discharges to a 36 inch storm sewer.

7. Sewerage:

All sanitary wastes from the facility either go directly to the Arthur Kill via a small tributary creek or are handled by a septic tank system. Domestic wastes from the executive offices and from the operations buildings go directly to the creek, while sewage from the warehouse is handled in a septic tank system and leaching bed.

Three 36 inch sewers, which reportedly carry storm water and cooling water, are located on the plant property. These conduits discharge directly to the creek.

8. Principal Processes:

The principal processes at this plant are secondary smelting and refining.

9. Waste Treatment:

Nassau Smelting and Refining Company, Inc., for all practical purposes discharge their industrial wastes without treatment. A pit has been provided in one area to receive waste from the Cottrell unit where large quantities of water are used for spray cooling. The effectiveness of this settling pit, at present, cannot be demonstrated.

## WATER POLLUTION ABATEMENT PROGRAM

At the present time, steps are being taken by Nassau Smelting to eliminate the use of Arthur Kill water. A new distillation procedure, which will char and crush the material will eliminate the need for the rotary hearth furnace; and thus the need for Arthur Kill water. Municipal water, connected to the plant's main cooling water system will be used in this new process.

It is the company s intent to connect all of their industrial and domestic discharges to the city sewer system when the city provides sewer elevations. As of this writing there is no indication as to when the City of New York will provide this information.

# Public Service Sewaren Generating Station

## Sewaren, N. J.

1. Organization:

The Sewaren Generating Station, located adjacent to the Arthur Kill in Sewaren, N. J., is owned and operated by the Public Service Electric and Gas Company, Newark, N. J. The installation, employing 235 people, operates 24 hours per day, 365 days per year. This facility was first put into operation in 1948.

2. Capacity:

This installation has a gross electrical output capacity of 975 megawatts. This includes a 140 megawatt gas turbine unit - the first of its kind in the United States.

3. Operations:

The plant produces electricity with five steam boiler-condenser-type generating units, and one gas turbine unit. The turbine unit does not require cooling water.

During peak operating periods all units are functioning. However, under normal daily operating conditions, only the five steam-type units are used.

4. Plant Design Capacity:

Electrical - 975 megawatts

Demineralizer Plant - designed to take water at approximately 1,000 micromhos and total dissolved solids of approximately 750 ppm and produce water of:

Total dissolved solids - 0.4 ppm
Dissolved silica - 0.02 ppm
Conductivity - 2.0 micromhos

Fuel Usage - (Quantity that would be used if units charged with only one of these fuels)

1. Coal - Grade: high bituminous
   - Consumption: 192 tons/hr on No. 1 thru 4 at rated load

2. Fuel Oil - Grade: Bunker "C" (used in units No. 1-5)
- Consumption: 1140 bbls/hr
- Grade: "Hi Vis" pitch (used in No. 5 only)
- Consumption: 510 bbls/hr

3. Natural Gas - Burned on No. 1-4 units at rate of 4,500,000 cu. ft/hr. Gas turbine uses 2,000,000 cu. ft/hr.

During average year fuel is used in the following manner: Coal - 75%; fuel oil - 24%; gas - 1%.

5. Water Supply:

A. Sources of water and rate of consumption

1. Salt water - Pumped from Arthur Kill by:

#1 Unit - 2 circulating pumps rated at 47,000 gpm each
#2 Unit - 2 circulating pumps rated at 47,000 gpm each
#3 Unit - 2 circulating pumps rated at 47,000 gpm each
#4 Unit - 2 circulating pumps rated at 47,000 gpm each
#5 Unit - 2 circulating pumps rated at 129,000 gpm each
Total circulating pumps - 634,000 gpm

Service water also pumped by four salt water pumps rated at 2,500 gpm each.

2. Fresh water - Source from two city water lines from Middlesex Water Company. Average consumption: 748,000 gpd

B. Use of water and rate of consumption

1. Salt Water

Cooling - Used for cooling #1-#5 condensers. Maximum consumption of 634,000 gpm, water tapped off #5 circulators for cooling #5 auxiliary coolers. Water from four salt water service pumps used for cooling in #1-#4 condensate coolers, #5 air compressor cooling, #5 pump water cooler, Hi-Vis condensate return pump heat exchanger, heating boiler deaerator vent condenser. These four pumps are rated at 2,500 gpm each. No. 1 gas turbine auxiliary cooling at 1850 gpm.

Salt water used for cooling in #1-#5 condensers is treated with chlorine. Chlorine is dispersed into #1-#5 pumps on a cycle of 40 minutes duration when the circulators are running. Only one pump is treated at a time. Rate can be varied from 0-8000 lb/day on No. 1-4, 0-12,000 lbs/day in No. 5. Residual chlorine at outlet of condenser is 0.5 ppm. Chlorination is provided three times per 24 hr day.

Process - Water from the four salt water service pumps is used for fire protection, ash sluicing, #51 & #52 air heater washing, #51 & #52 traveling screen washing nozzles, and sewage ejector pit.

2. Fresh Water - treated in demineralizer plant for use in steam cycle of #1-#5 units. Portion used for drinking, cooking, showers, and other service facilities. Approximate consumption of 99,900 cu. ft/day.

6. Sewage:

Sanitary wastes from this facility are discharged to the Sewaren municipal treatment plant.

## WASTE SOURCES AND TREATMENT

7. Demineralizer Waste:

Wastes from the demineralizing plant consists of dilute solutions of sulfuric acid and caustic soda used to regenerate the ion exchange resins in the make-up demineralizing and the mixed bed condensate polishing units.

8. Quantity of Waste:

At design conditions, the combination of acid and alkaline waste from the make-up demineralizing plant and condensate purification plant produces a net acid excess of 1,160 pounds per day. The details of the waste flows from the demineralizing plant are shown in Table I entitled, "Regeneration Waste Data, Sewaren Generating Station", dated December 7, 1961.

9. Method of Disposal:

The waste from the demineralizing plant is collected in a basin where the acid and alkaline wastes are air mixed. From this basin, the waste is fed to the flowing water in the circulating water discharge canal at a controlled rate. This circulating water is taken from the Arthur Kill and pumped through the condenser and then into the canal through which it is discharged back into the Kill. Normally, five condensers are in service and the flow through the canal is 634,000 gpm. With the waste flows shown in Table I, this controlled rate is 80 gpm and results in a decrease in alkalinity of .153 ppm in the canal under normal operating conditions.

10. Description of Facilities:

The waste disposal basin has a capacity of 152,000 gallons. This design is predicted on a condition where peak waste flows from a mixed bed unit and a primary cation-anion make-up unit occur simultaneously. The maximum surge that occurs at this time is 52,000 gallons. Therefore, the mixing tank surge capacity is set at 53,000 gallons with a retention volume of 52,000 gallons, for a total mixing section of

105,000 gallons. The volume of the effluent section is 47,000 gallons so that with an empty basin there is a total surge capacity of 100,000 gallons. The effluent section prevents short circuiting between the inlet and outlet. If the maximum waste flows occurred simultaneously from all units, the maximum surge would be 87,000 gallons.

The basin is constructed of concrete with a caustic and acid proof brick lining. Piping to and from the waste basin is rubber lined and, where necessary, rubber or mastic coated. The control valve provided in the waste basin outlet can be adjusted to maintain any desired outlet flow rate.

To give adequate mixing of the waste solutions, air is introduced through a grid in the mixing section. This grid is designed to provide a maximum of 700 scfm of air into a full basin to aerate as well as mix the waste prior to disposal. A pressure regulating valve reduces the 300 psi or 125 psi compressor air discharge to 50 psi for the air grid supply pressure. A locally installed plug valve is used for the final setting of air required to produce a gentle rolling motion of the basin solution. Cut outs on both compressor pressure controllers have been provided so as to trip the basin air supply if the station air pressure decreases due to abnormally high demand.

A pH indicator-recorder is provided to monitor the water in the discharge canal below the point of chemical waste addition. Provision is made on the recorder to add pH indication upstream of the injection point at a later date, if it should become desirable.

### 11. Boiler Acid Cleaning Waste

Provision is made for carrying spent acid (HCl) solutions used in boiler chemical cleaning to the waste disposal basin. The waste basin holds approximately four boiler volumes, which is enough capacity to accommodate all boiler drains from any boiler cleaning operation. These solutions are completely neutralized by adding caustic soda directly to the waste basin prior to discharge into the canal. Boilers are cleaned, based on condition, every 1 to 10 years.

### 12. Solid Wastes - Slag and Fly Ash:

Slag and fly ash from units No. 1-4 is either sent to the waste ponding area adjacent to the plant site, or to the breaker house where it is sold in bag or bulk form. The ponding area, consisting of two interconnected earthen diked lagoons, discharges to the Arthur Kill.

### 13. Thermal Pollution:

Cooling waters discharged to the Arthur Kill are at a temperature 15° F higher than that of the intake water. Information on how far up or downstream this temperature elevation is detectable is unavailable.

## TABLE I

### REGENERATION WASTE DATA
### SEWAREN GENERATING STATION
### PUBLIC SERVICE ELECTRIC AND GAS COMPANY

| | Number Installed | Service Cycle Hours | Regen. Cycle Minutes | Maximum Normal Regen. Per Day | Gallons To Waste Basin Per Regen. | Gallons to Waste Per Day | Pounds Chemical Per Regen. | Pounds Chemical to Waste Per Regen. | Pounds Acid Waste Per Day | Pounds Caustic Waste Per Day |
|---|---|---|---|---|---|---|---|---|---|---|
| Primary Cation | 2 | 16 | 167 | 2.56 | 25,570 | 65,200 | 1,000 | 600 | 1,538 | - |
| Primary Anion | 2 | 16 | 167 | 2.56 | 12,280 | 31,400 | 443 | 150 | - | 384 |
| Secondary Cation | 3 | 119 | 100 | 0.596 | 6,600 | 3,940 | 800 | 550 | 328 | - |
| Secondary Anion | 2 | 34 | 124 | 1.33 | 4,915 | 6,560 | 320 | 200 | - | 266 |
| Mixed Bed | 2 | 336 | 280 | 0.143 | 54,900 | 7,850 | 1,800<br>1,000 | 1,600<br>800 | 228 | 114 |
| | | | | | | 114,950 | | | 2,094 | 764 |

Effluent valve setting - 114,950 gal/day times 1 day/24 hr times 1 hr/60 min = 80 gpm.
One pound NaOH will neutralize 1.225 pounds $H_2SO_4$.
Seven hundred and sixty-four pounds NaOH will neutralize 935 pounds $H_2SO_4$.
Acid excess per day = 2,094 - 935 = 1,160 pounds
Normal discharge canal flow (five units) = 7,600,000,000 pounds per day
Ppm = 1.160/7,600 = 0.153 $H_2SO_4$ = 0.156 as $CaCO_3$.

# Public Service, Linden Generating Station

## Linden, New Jersey

1. Organization:

The Linden Generating Station, located adjacent to the Arthur Kill in Linden, New Jersey, is owned and operated by Public Service Electric & Gas Company, Newark, New Jersey. The installation employing 175 people, operates 24 hours a day, 365 days per year. This plant was first put into operation in 1956.

2. Capacity:

This installation has a gross electrical capacity of 510 megawatts. On a yearly basis, the electrical production of the plant is 62.4 percent of the design capacity.

3. Operations:

Construction of the Linden Generating Station adjacent to the Esso Bayway Refinery is a mutually advantageous combination of two industrial processes; namely, the processing of crude oil to refined petroleum products and the conversion of refinery residuals to electric energy. The refinery uses the generating station's low level heat energy effectively; and the generating station makes good use of the residuals of the refining process. The contractual agreement provides that Public Service will deliver to Esso, the entire steam requirement of the Bayway Refinery, in exchange for fuel and raw water.

The Linden plant consists of one automatic double-extraction and one automatic single extraction turbine-generator. Unit number one, with a capacity of 260,000 KW gross, has three boilers on a header, serving both the turbine and the pressure reducing and desuperheating equipment, which bypass the turbine for delivery of steam from the boilers directly to the refinery. The plants second generating unit, with a capacity of 250,000 KW is designed so that it too can furnish extraction steam to the refinery at an extraction pressure of 150 psi during peak periods. This unit is provided with only one boiler.

Because of the contractual arrangement with Bayway, only two fuels are burned at the Linden Generating Station: Bunker "C" - 1,500,000 bbls/years and "Hi-Vis" - 3,700,000 bbls/year.

4. Water Supply:

Essentially, three sources of water are available, namely Elizabethtown Water Company - 1.73 mgd; Humble Oil and Refining Company - 1.15 mgd; and salt water from Arthur Kill - 345 mgd.

All of the fresh water, 2.88 mgd, with the exception of a very small quantity used for sanitary and drinking purposes, is used to produce steam for the Bayway Refinery of the Humble Oil and Refinery Company.

Salt water, used for cooling two condensers, is pumped from the Arthur Kill by four units; two rated at 70,000 gpm and two at 50,000 gpm. Kill water is chlorinated primarily to control slime growths. Two units, each with a capacity of 8,000 lbs/day, are used. A residual of 1.0 mg/l at the condenser effluent is maintained whenever possible. During an eight hour period, a circulator pump will receive one hour and fifty minutes of chlorination. Chlorination is practiced 24 hours per day.

Fresh water supplied by Elizabethtown and Humble Oil is treated in a two stage water treatment plant: Primary treatment and demineralization. Operation of these stages is described below.

## PRIMARY TREATMENT

Water from Esso's reservoirs is delivered by refinery pumps to a 500,000 gallon raw water tank. An automatic chlorine demand meter controls a chlorine feeder to supply chlorine in breakpoint quantity for reduction of organic impurities to a minimum. From the storage tank water passes to a 15,000 gallon flash mixing tank where it receives coagulating chemicals of alum, coagulant aid; and when conditions warrant, powdered activated carbon and acid or caustic soda. From the mixing tank the now chemically treated water flows by gravity to two all steel solids contact clarifiers each 62' diameter by 18' high.

Clarified water flows into four gravity filters which contain deep beds of anthracite filter medium. These filters are annular segments, two being constructed at the periphery of each clarifier. Filtered water flows into storage tanks (clearwells) located below each pair of filters in which level is controlled and from which the filtered water pumps take their suction.

Water is prescious at Linden and no water is wasted that can be reclaimed for use. The 100,000 gallons of water required to surface wash and backwash each filter is reclaimed by draining to a large compartment at the periphery of one of the clarifiers from where it is repumped to the flash mixing tank. Filtered water storage (379,000 gallons) is available from similar compartments in both vessels.

The entire primary plant is designed to operate unattended, by remote, manual or automatic control. It is capable of producing 3,750 gpm of water essentially free of turbidity, color, oil and organic matter so that the next treating process, demineralization, can function unhampered by such impurities.

## DEMINERALIZER

Water is delivered from the primary plant to seven cation resin exchangers, each 12' diameter by 18' high for removal of calcium, magnesium and sodium. These units are regenerated with sulfuric acid when the resin beds are exhausted. Automatic effluent throttling valves accurately divide the flow through the cation units. Cation cycle lengths are determined by an electronic conductivity difference control system. Both the cascade flow control and regeneration on the basis of cation effluent conductivity are fully automatic, but push-button manual control of regeneration is available for operator's use.

Acid water from the cation units flows to a three-stage rubber lined vacuum degasser, 14' diameter by 40' high for removal of soluble carbon dioxide and oxygen. The degasser is held under vacuum by mechanical vacuum pumps and water is pumped from the storage section of the degasser by stainless steel pumps to the combination anion exchangers.

Anion exchangers are of double deck design, six in number, each 12' diameter by 29' high and contain weak base resin in the upper deck for removal of sulfate, chloride and nitrate components from the cation free water. The lower deck of the anion unit has a 36" bed of strong base resin for removal of silica and residual carbon dioxide. Conductivity controls on both weak base and strong base anion effluents govern length of cycles by automatically removing units from service when water quality falls below a predetermined set point.

Water quality at the outlet of the anion exchangers is very high, in the usual sense, since the water has now been demineralized. However this quality is not considered high enough for the Linden equipment, and the treating process is continued in five 12 diameter by 14' high, flat bottom, mixed bed demineralizer units. In these vessels, water is redemineralized or "polished" and attains a high purity. Each vessel is capable of handling approximately 5,000,000 gallons of water before being exhausted by residual solids from the preceding demineralizing units. Cycle control is volumetric, with conductivity backup.

The demineralizing plant is designed to produce continuously 3,200 gpm of water of guaranteed quality. Provisions have been made for future expansion of the plant to 4,800 gpm capacity.

Water from the outlet of the mixed bed demineralizers flows to two 500,000 gallon demineralized water storage tanks from which feedwater makeup is drawn as required.

Automatic regeneration facilities for cation, anion and mixed bed units are installed in duplicate. Concentrated sulfuric acid and caustic soda are stored in liquid storage tanks for regeneration requirements.

At the present time, water production is operating at approximately 55 percent of design.

## SOURCES OF POLLUTION

5. Demineralizer Wastes:

Wastes from the demineralizer plant consists of dilute solutions of sulfuric acid and caustic soda which is used to regenerate the ion exchange units. At the present time, approximately 1,500 to 3,000 lbs/day - 1,200 lbs/day average - of excess acid is discharged. The maximum discharge capacity is 7,500 ppd of excess sulfuric acid.

6. Primary Treatment Unit:

Sludge from the primary treatment units amounts to approximately 9,640 gallons. It is discharged at a rate of 482 gpm for a 20 minute period, to the plant's cooling water canal. Filter backwash is held in a storage compartment in the base of the sedimentation unit and fed back into the raw water supply.

7. Ash and Slag Wastes:

Because the Linden Generating Station burns all liquid fuel there is no resulting coal ash or slag. Ash resulting from the liquid fuel, which is low in ash quantity, is removed from the boilers during overhaul in dry form and usually sold for its vanadium content.

8. Thermal:

Cooling waters discharged to the Arthur Kill are at a temperature 15$^{\circ}$ higher than that of the intake water. Information on how far up or downstream the temperature elevation is detectable is unavailable.

## WASTES TREATMENT

Wastes from the demineralizing plant are air mixed in a neutralization basin constructed of concrete, with a caustic and acid proof brick lining. Piping to and from the basin is rubber lined and where necessary, rubber or mastic coated. A control valve in the basin can be adjusted to maintain any outlet flow rate (present rate is 411 gpm) to the salt water discharge canal.

Spent hydrochloric acid solutions, used for cleaning boilers - approximately once per year - are completely neutralized by adding caustic soda directly to the basin.

# Consolidated Edison, Arthur Kill Generating Station

## Staten Island, N. Y.

1. **Organization:**

This generating plant of the Consolidated Edison Company of New York, Inc., built in 1959, is located on the Staten Island shore of the Arthur Kill opposite the mouth of the Rahway River.

A total of 126 people - based on around-the-clock operation - are employed.

2. **Capacity:**

Gross electrical output of this facility is 360,000 KW. Net output is 349,000 KW.

3. **Operation:**

A single generating unit - cross compound machine - consisting of two separate generators electrically linked together provides the total output of this station. It is impossible to operate one generator without the other.

Coal, used at a rate of 2,500 tons per day, is the main fuel source. Number 6 oil is normally used for starting and emergency purposes.

4. **Water Supply - Treatment:**

Two sources of water, namely, Arthur Kill and the New York municipal supply, are available at this plant.

Salt water from the Arthur Kill, used for condenser cooling, is pumped at a rate of 244,000 gpm - 351 mgd. Two pumps, each with a capacity of 122,000 gpm are used for this purpose. Two 16,000 gpm salt water service pumps - used for supplying washwater for screens, clean-up, etc. - have also been provided.

In order to keep heat transfer tubes clean it is necessary to chlorinate the condenser cooling water. Fifteen percent sodium hypochlorite, fed at a rate of 5 gpm during the winter and 10 gpm during the summer, is used for this purpose. The dosage time for each condenser pump is 30 minutes, three times per day. During winter the residual at the condenser effluent is 2.0 mg/l, while in the summer, it is difficult to maintain 1.0 mg/l.

Ferrous sulfate solution is also added three times a day for a 40-minute period to produce a 1 ppm concentration in the cooling water. The total Fe added is about 20 lb during each addition.

Fresh water from the New York City system is used at an average rate of 120,000 gpd. Treatment plant throughputs between regeneration periods are as follows: Softener - 4 to 5 million pounds (540,000 gallons); demineralizer - 1.2 - 1.5 million pounds (162,000 gallons).

Throughout the year the softener will be regenerated approximately once every six and one-half days. Thirteen hundred pounds (1,300 lbs.) of dilute 66° Be sulfuric acid are used for each regeneration. The demineralizer, regenerated every seven days, uses 160 pounds of $H_2SO_4$ and 180 pounds of sodium hydroxide.

5. Sewerage:

All sanitary wastes are discharged to a municipal sewer, which in turn, empties into the Kill.

## WASTE SOURCES - TREATMENT

6. Softener:

Acid wastes from the softener are discharged into the canal carrying the plant's cooling water, which flows at a rate of 244,000 gpm. Acid is discharged over a one hour period, starting with a concentration of 5% $H_2SO_4$ in the rinse, and ending with zero percent $H_2SO_4$. Reportedly, the pH in the canal is 7.1 during the rinse cycle.

7. Demineralizer:

Caustic and acid are discharged to the canal for a one hour period during the rinse cycle. The pH in the canal water during this period is reported to be 7.4 to 7.5.

8. Boiler Acid Cleaning Wastes:

The boiler is acid cleaned approximately once a year. The total hydrochloric acid drained to the discharge canal is about 27,000 pounds over a one-hour period at a strength of about 3% HCl. During the draining period the pH in the discharge canal is lowered to approximately 6.0.

9. Fly Ash and Slag:

Fly ash and slag are discharged to two separate diked lagoon areas adjacent to the plant. Overflow from these lagoons empties directly into the Arthur Kill.

An analysis of the fly ash, made by Con Edison, follows:

| | Percentage Range |
|---|---|
| Silica ($SiO_2$) | 31 - 44 |
| Iron Oxide ($F_2O_3$) | 17 - 34 |
| Aluminum Oxide ($Al_2O_3$) | 24 - 34 |
| Calcium Oxide (CaO) | 3.5 - 6.1 |
| Magnesium Oxide (MgO) | 1.1 - 3.0 |
| Sulfur Trioxide ($SO_3$) | 0.8 - 1.2 |
| Sodium Oxide ($Na_2O$) | 0.1 - 0.3 |
| Potassium Oxide ($K_2O$) | 0.3 - 0.4 |
| Carbon (C) | 3.5 - 5.8 |

The phosphorous content of the ash, analyzed by Con Edison at the request of the Raritan Bay Project, was 0.1% by weight.

Settling time in the fly ash lagoon is estimated to be 3 to 7 days.

## 10. Temperature Elevation:

Cooling water, obtained from the Arthur Kill, is elevated in temperature 12.5°F. Information on how far up or downstream a temperature increase is detectable, is not available.

## Jersey Central Power and Light Company, E.H. Werner Generating Plant

## South Amboy, N. J.

1. **Organization:**

The E.H. Werner Generating Station, is located adjacent to the Raritan River at a point 0.5 miles from its STORET mouth. It is owned and operated by the Jersey Central Power and Light Company and employs 112 people. It first began operations in 1930 and operates 24-hr. per day, 365 days per year.

2. **Capacity:**

This installation has a gross electrical output capacity of 118.75 megawatts with a net output of 108.4 megawatts.

3. **Operations:**

The plant produces electricity with 3 steam boiler-condensor turbo-generator units. The plant has a total of four boilers.

4. **Plant Design Capacity:**

**Electrical** -- 118.75 megawatts

Unit #4 - 62.5 megawatts
Unit #1 - 28.125 megawatts
Unit #3 - 28.125 megawatts

**Demineralizer Plant** - has a capacity of 22 gpm. Produces a water with conductivity range of 5-15 micromhos.

**Fuel Usage** (1965 operating values)

1. Coal - Bituminous, high volatile, low fusion grade. Consumption was 421 tons avg. per operating day in 1965.
2. Fuel Oil - Units #1 and #3 burn fuel oil only - Unit #4 can burn either coal or fuel oil. Consumption is 300,000 to 350,000 barrels per year.

**Evaporators**

This plant uses three evaporators to provide the bulk of its boiler makeup water requirements. #1 has a capacity of 1000 gallons/hour, #3 has a capacity of 1000 gallons/hour, and #4 has a capacity of 2500 gallons/hour.

5. Water Supply:

A. Sources of water:

1. Salt Water - pumped from the Raritan Bay by:

#1 unit - 2 circulating pumps at 21,000 gpm each
#3 unit - 2 circulating pumps at 21,000 gpm each
#4 unit - 2 circulating pumps at 35,000 gpm each
and a 2,000 gpm pump for slag quenching and transport.

2. Fresh Water

Source is own well with a capacity of 200 gpm located on the plant grounds and the city of South Amboy for 30,000 gallons per month.

B. Use of Water

1. Salt Water:

The salt water is used for condensor cooling, bearing cooling, slag quenching and washing. The condensor cooling water is chlorinated to maintain a 1 mg/l residual in the effluent. The chlorine is added as a gas every 8-hours during the warmer months from April through November or December. Approximately 2/3 of a ton per day is used.

2. Fresh Water

Used for boiler makeup water, and employee use. The boiler makeup averages 1% of the total use. The total fresh water requirement is approximately 251,000 gallons per day. (250,000 well plus 1,000 city)

## WASTE SOURCES AND TREATMENT

6. Demineralizer Waste:

Wastes from the demineralizing plant consists of dilute solutions of sulfuric acid and caustic soda used to regenerate the ion exchange resins in the makeup demineralizing units.

7. Quantity of Waste:

The demineralizer is regenerated with 36 gallons of a 5% HCl acid solution 3 times per week for the cation unit and with 65 gallons of a 4% caustic solution 3 times per week for the anion unit. Both cation and anion beds are backwashed at 15 gpm 3 times per week for 15 minutes each wash. The demineralizer will provide 25,000 gallons of finished water from each cycle.

8. Method of Disposal:

The wastes from the demineralizer plant are discharged without treatment to the condensor cooling water discharge canal.

9. Boiler Acid Cleaning Waste:

It has been 6 years since this plant last cleaned a boiler. When cleaning, they use an ammoniated citric acid solution. The spent acid solution is put in the river with the condensor cooling water.

10. Solid Wastes -- Slag & Fly Ash:

Both of these wastes are collected and transported to the settling ponds adjacent to the plant. The plant sells the slag and fly ash to a local contractor who uses the material in paving.

11. Thermal Pollution:

Cooling waters discharged to the Raritan Bay are at a temperature 8 to 10°F higher than that of the intake water. Temperature data on the influent and effluent condensor cooling water for year 1966 and 1965 is given below in °F:

| Month 1966 | Inf. | Eff. | Month 1965 | Inf. | Eff. | Month 1965 | Inf. | Eff. |
|---|---|---|---|---|---|---|---|---|
| Jan. | 36.9 | 42.8 | Apr. | 48.7 | 55.9 | Aug. | 76.5 | 84.3 |
| Feb. | 37.4 | 45.5 | May | 67.3 | 72.7 | Sept. | 72.6 | 80.1 |
| Mar. | 40.6 | 47.9 | June | 68.9 | 76.1 | Oct. | 60.7 | 69.4 |
|  |  |  | July | 76.3 | 84.2 | Nov. | 49.4 | 58.4 |
|  |  |  |  |  |  | Dec. | 44.3 | 52.1 |

## Jersey Central Power and Light, Sayreville Generating Station

## Sayreville, New Jersey

### 1. Organization:

The Sayreville Generating Station, located adjacent to the Raritan River approximately 6.20 miles from its STORET mouth, is owned and operated by Jersey Central Power and Light. The installation employs 160 people and operates 24 hours a day, 365 days per year. The plant was first put in operation in 1930.

### 2. Capacity:

The plant has a gross electrical output capacity of 376 megawatts, and a net electrical output capacity of 354 megawatts.

### 3. Operations:

The plant produces electricity with 4 condensing turbine units and 1 topping turbine unit. The topping unit requires no cooling water per se. In essence, the plant consists of three plants. Units 1, 2 and 3 called the old plant were installed in the early thirties, and have a combined gross output of 100 megawatts. These units have six boilers (#5 and #6). The new plants, units 4 and 5 each have a gross capacity of 138 megawatts and one boiler each (#7 and #8 respectively).

In normal operation, units 4 and 5 are used continuously with the old units 1, 2 and 3 used for peak power demands.

### 4. Plant Design Capacity:

**Electrical** - 376 megawatts

Following is the name-plate capacity of each generator:

| | Gross Output Megawatts | Temp $^{\circ}$F | Pressure psig |
|---|---|---|---|
| Unit 1 | 33.75 | 600 | 300 |
| Unit 2 | 33.75 | 600 | 300 |
| Unit 3 | 25.974 | 900 | 875 |
| Unit 4 | 122.5 | 1050 | 2000 |
| Unit 5 | 125.0 | 1050 | 2000 |

**Demineralizer Plant**

This plant utilizes city of Sayreville water and consists of 4-two bed systems (cation and anion units in series) and 2-mixed bed systems (cation and anion resins homogeneous mixture). The mixed bed units are used as polishers after the two bed units. Each unit has a 60 gpm capacity. The cation units are regenerated with 1230 gallons of 1.6% solution of $H_2SO_4$ and the anion units with 1136 gallons of a 1.6% solution of caustic (sodium hydroxide). Each two bed unit will pass approximately 70,000 gallons of water before regeneration is required and the mixed bed units will approximately 1,000,000 gallons. The finished water has a quality of 0.5 to 7.0 micromhos conductivity, depending on the quality of the resin.

### Fuel Usage

Following is the actual fuel consumption for the year 1965:

Coal: 542,391 tons Bituminous grade
Fuel Oil: 395,460 gallons #2 grade
Natural Gas: 4,504,155 million cubic feet

## 5. Water Supply:

### A. Sources of Water

1. Salt Water - from Raritan River

#1 unit - 2 circulating pumps each rated at 23,500 gpm
#2 unit - 2 circulating pumps each rated at 23,500 gpm
#3 unit - Topper unit with no cooling water required - steam exhausts into steam header for units 1 and 2.
#4 unit - 2 circulating pumps at 37,700 gpm each
#5 unit - 2 circulating pumps at 37,700 gpm each
Total circulating pump capacity = 244,800 gpm

In addition to the condenser cooling water pumps, salt water is pumped for ash transport.

#1,2,3 units - 3 pumps rated at 1200 gpm
#4 unit - 2 pumps rated at 1000 gpm
#5 unit - 2 pumps rated at 700 gpm

2. Fresh Water - source from city of Sayreville. The average water use for 1965 was 0.32 mgd and varied monthly as follows for the year 1965:

| | | | | | |
|---|---|---|---|---|---|
| Jan. | 0.295 | May | 0.255 | Sept. | 0.361 |
| Feb. | 0.267 | June | 0.356 | Oct. | 0.409 |
| March | 0.325 | July | 0.325 | Nov. | 0.296 |
| April | 0.355 | Aug. | 0.297 | Dec. | 0.306 |

## B. Use of Water

### 1. Salt Water

Cooling - used for cooling #1, #2, #4 and #5 condensers. The maximum usage would be 244,800 gpm or 353 mgd. During the year the pumps are operated as follows:

Units 1 and 2 - During 4 winter months (Dec. Jan, Feb and Mar) two of the 23,500 gpm pumps do not operate at all. For 8 months per year, all 4 - 23,500 gpm pumps will not be operated during the weekends. During the week days, for 10 hours each day, 2 of the 23,500 gpm pumps are off for 12 months per year. Approximately 7 weeks of the time, 2 are out for 24-hours per day. On a yearly basis, the pumps for units 1 and 2 average 55 mgd. During the 8 warm months they average 65 mgd while during the 4 winter months they average 12 mgd. The maximum pumpage would be 106 mgd and would occur for a 5-day duration.

For units 4 and 5, during approximately 3 months of the year when the water temperature is below 40°F, only 2 of the 37,700 gpm pumps are operated. The remainder of the time both are operated.

The total maximum warm weather pumpage is then approximately 323 mgd. During the winter months the rate would be approximately 150 mgd.

The ash transport pumps for units #1, 2 and 3 operates approximately 2 hours per day during the gas season (April through Sept.) and 4 hours a day during the remainder of the year. The #4 unit pump operates 3 hours per day during the gas season and 6 hours per day otherwise. The #5 unit operates 12 hours per day regardless of season. The warm weather pumpage then averages 0.88 mgd while the cool weather average is 1.2 mgd.

The salt water is used for condenser cooling and ash transport.

The salt water used for the condenser cooling is chlorinated at the rate of 1 mg/l with an average residual of 0.5 mg/l in the effluent resulting.

Units 1 and 2 are chlorinated every 4 hours with 34 lb of chlorine gas when the water temperature is about 45°F. Below 45°F the treatment is every 6 hours.

Units 4 and 5 are treated at the same frequency with 50 lb of chlorine gas per treatment. Each treatment takes 20 minutes. In 1965, 75 tons of chlorine were used.

2. Fresh Water - treated in the demineralizer plant for use in the steam cycle of units 1 through 5. Portion used for drinking, washroom facilities and etc.

6. Sewage:

Sanitary wastes from this plant are discharged to a 3000 gallon septic tank with a 100' x 66' tile drainage field. This field lies to the east of the main plant. There is no direct discharge to the river.

## WASTE SOURCES AND TREATMENT

7. Demineralizer Waste:

Wastes from the demineralizing plant consists of dilute solutions of sulfuric acid and caustic soda used to regenerate the ion exchange resins in the two-bed and mixed bed units.

8. Quantity of Waste:

The quantity of waste produced by the demineralizer consists of 2230 gallons (1230 regeneration w/1.6% $H_2SO_4$ followed by 1000 gallons rinse water) for each cation bed; 2636 gallons (1136 regeneration w/1.6% caustic followed by 1500 gallons rinse water) for each anion bed. Approximately 300 gallons of water are used in each bed for backwash. The combination of the waste waters gives an alkaline mixture.

9. Method of Disposal:

The waste from the plant is collected in a sump. From here it is pumped into the condenser cooling water intake canal. It then flows through the condenser and is discharged with the cooling water.

10. Description of Facilities:

The disposal facilities consist entirely of the sump storage area and pumps to the condenser cooling lines.

11. Boiler Acid Cleaning Waste:

An ammoniated citric acid solution fortified with 0.2% sodium nitrite and a wetting agent is used for acid cleaning the boilers. Boilers are cleaned, based on condition, every 1-10 years. The cleaning waste, approximately 30,000 gallons, flows to the condenser cooling water lines before cooling the condensers.

12. Solid Wastes - Slag and Fly Ash:

Slag and fly ash from all five units is sent to the waste ponding area adjacent to the plant site. The solid wastes settle out and the water is returned to the Raritan River. Approximately 28,000 yards of slag and ash per year is collected and carted away by a contractor.

13. **Thermal Pollution:**

Cooling waters discharged to the Raritan River are at a temperature 10 to 15°F higher than that of the intake water. The following table gives the average monthly temperatures in °F for the condenser outlet and inlet lines and for units 1,2,3 and 4+5. This data is for year 1965.

|  | Influent |  | Effluent |  |
|---|---|---|---|---|
| MONTH | Units 1,2,3 | Units 4,5 | Units 1,2,3 | Units 4,5 |
| Jan | 38.2 | 36.0 | 46.7 | 49.1 |
| Feb | 37.0 | 35.6 | 46.6 | 48.7 |
| Mar | 43.2 | 43.2 | 51.3 | 54.7 |
| Apr | 52.9 | 51.0 | 59.6 | 64.1 |
| May | 68.5 | 67.5 | 76.1 | 80.1 |
| June | 74.2 | 73.8 | 82.5 | 86.6 |
| July | 80.3 | 79.5 | 88.3 | 93.1 |
| Aug | 80.0 | 79.5 | 88.8 | 93.2 |
| Sept | 74.9 | 74.6 | 83.3 | 87.0 |
| Oct | 62.4 | 62.3 | 71.1 | 76.5 |
| Nov | 51.1 | 49.2 | 60.7 | 62.1 |
| Dec | 44.0 | 43.6 | 54.1 | 56.5 |

## International Flavors and Fragrances Incorporated

## Union Beach, N. J.

### 1. Organization:

This plant of International Flavors and Fragrances Inc., is located on the southern shore of Raritan Bay at Union Beach, New Jersey. The facility employs approximately 350 people and is operated on a 24 hour, six day per week basis. Approximately 75 percent of the force works during the day and the remainder at night. The company's main executive and operating offices are located in New York City.

### 2. Products - Operations:

This installation is engaged in the production of intermediate essence and essential oils. The manufacture of these products involves compounding, processing, reacting and distillation of various chemical products. The operations are usually batch type and involve the use of in excess of 400 separate chemicals. In excess of 300 separate production materials are produced during the calendar year. Two products - Myrcene and Phenyl Ethyl Alcohol - are produced almost continuously.

### 3. Water Supply:

International Flavors and Fragrances maintains its own domestic and industrial water supply. At the present time three wells are on the property, however, only two of these sources are active. The combined capacity of these two wells is 635 gpm, with one having a capacity of 500 gpm. In the event of a breakdown within the plant - pressure maintained at approximately 80 psi - city water at approximately 55 pounds will cut in automatically.

The well water, which is obtained from a depth of 300 feet, is extremely soft, and high in hydrogen sulfide, carbon dioxide, and ferrous iron. A Zeolite softener reduces the iron content from 9 ppm to .1 ppm; chlorine is used to remove the remainder. $H_2S$ and $CO_2$ are removed by aeration.

The total water consumption at the plant site has been shown to average 130 gallons per minute and may be accounted for in the following table:

| | gpm |
|---|---|
| Boiler House makeup | 35 |
| Cooling tower consumption | 30 |
| Domestic usage | 10 |
| Flow to waste treatment plant | 25 |
| Dilution water for experimental waste treatment plant | 10 to 20 |
| Miscellaneous losses, production retention and untreated discharge | 10 |

4. **Sewage:**

All sanitary wastes are treated in septic tanks. At the present time there are five different systems with tile fields serving the plant.

5. **Waste Characteristics:**

The waste reaching the treatment plant is an intermediate strength acid solution containing small amounts of lost aromatic chemicals and solvents. Stable salts of reactive materials are also present in the flow. Analytical determinations to specifically identify various forms of materials present have been unsuccessful. The strength of the waste has therefore been generally described in terms of its total dissolved solids, suspended solids, BOD and COD.

6. **Treatment Facilities:**

The present waste treatment plant consists of primary sedimentation and oil separation followed by chemical coagulation and precipitation. The effluent from these processes is then equalized for four days before discharge. The separated oils are drummed for disposal off site while the precipitated sludge is lagooned within company property. The effluent from the plant is discharged to a diffusion field on company property. During the summer months some leaching into Raritan Bay has been reported. Present treatment provides total removal of floating oils, 95% reduction in suspended solids and approximately 50% BOD reduction. The discharge from the treatment works averaged 25 gallons per minute flow, 2530 lbs BOD per day and less than 50 lbs per day suspended solids during the period August 1964 to August 1965. Influent samples to the plant are not obtained on a routine basis due to analytical and collection problems.

In an effort to develop feasible methods of improving waste treatment in the plant, the Company has, for the past 3-1/2 years, been engaged in extensive research and experimentation. It is recognized that the next step in the development of treatment is the establishment of a biological system to further degrade the wastes. Experimentation has indicated that the total dissolved solids concentration of the waste is in itself an inhibiting agent to effective biological treatment. The Company has, however, developed a process, similar in concept to an aerated lagoon treatment, which is capable of reducing the remaining waste load to less than 300 lbs BOD per day during the warm weather months. The present process has the marked disadvantage of requiring three gallons of water for each gallon of waste treated. Experimentation is proceeding to eliminate or greatly reduce this water requirement. The Company's present experimentation is on a pilot plant capable of providing 95% reduction for approximately one fourth of the plant flow.

7. **Untreated Wastes:**

Two other waste sources have been identified in the plant that do not reach the combined treatment system. The first of these involves a stream containing high concentrations of aluminum chloride. This stream, although low in volume, causes significant difficulties when admixed with other wastes in the treatment system. At present, the largest portion of this waste is stored and periodically removed by truck from the plant site. The dilute washings from the process are discharged directly into the plant dispersion field. Studies are presently underway to provide pretreatment for this waste so that it may be discharged to the waste treatment plant. The remaining source of discharge is a small intermediate chemical process which sometimes produces a dilute chromate solution. Chromium present in this stream is always converted to the trivalent form before discharge to the ground.

## S. S. White Company, Prince Bay

## Staten Island, N. Y.

### 1. Organization:

This plant is a solely owned non-affiliated firm, with executive offices in Philadelphia, Pa. It was known formerly as the S.S. White Dental Manufacturing Company. The plant owns 15 acres in Prince Bay, Staten Island, of which 5 acres are occupied. Approximately 350,000 square feet of floor space is in use. There are a total of 650 employees, including office personnel and operating staff, at this plant.

### 2. Products:

This plant of S.S. White produces annually the following:

Dental Burs and Handpieces - 4,500,000
Dental furniture -- Chairs: 2,000; Dental Units: 1,200
Nitrous oxide - 110,000,000 gallons
Dental filling and impression materials - 76,000 lbs.
Molded plastics - 48,000,000 pcs.
Resistors - 100,000 pcs.
Flexible shafting - 40,000,000 feet
Flexible shafting - fittings 50,000 pcs.

### 3. Raw Materials:

Raw Materials - annually used - include:

Iron: Pig 25 tons - Scrap 15 tons - Steel 90 tons
Brass 30 tons
Chromic Acid - 1000 lbs
Nickel salts - 800 lbs
Copper - 500 lbs
Cadmium - 100 lbs
Zinc - 200 lbs
Cyanides - 500 lbs
$H_2SO_4$ - Sulfuric acid - 5000 lbs
Potassium permanganate -- 500 lbs
NaOH - Sodium hydroxide - 200 lbs
Ammonium nitrate - 1500 tons
Plastics - 90 tons
Aluminum: Bar & sheet 11,000 lbs - Castings 85,000 lbs

### 4. Capacity:

Quantities listed in Section 5 represent about 85% of plant capacity.

5. Operations:

The plant is in operation 5 days per week, 8 hours per day, on a year long basis. Some departments work 16-22 hours a day but no appreciable waste discharge takes place during these extended shifts. During a normal day the only continuous discharges are in the plating and rinsing sections.

6. Water Supply:

Fresh water from New York City is used at a rate of approximately 57,000 gallons per day. Salt water, pumped from Raritan Bay at a rate of 1,000 gpm, is used for cooling purposes.

7. Sewerage:

Two separate sewer systems serve this facility. Sanitary wastes flow by gravity through a 12-inch sewer to a 1,800 gallon chlorine retention tank. The chlorinated effluent is then mixed with the cooling water return prior to being discharged to Raritan Bay.

Industrial wastes are collected in 12-inch sewers and discharged directly to the Bay without treatment.

Approximately 100 lbs per month of chlorine is used for disinfection. The effectiveness of this treatment is questionable since the contact tank is subject to flooding during high tides. Also, no attempt is made to maintain a "bacteria killing residual"--chlorine is fed at the same rate, regardless of flow.

8. Principal Processes:

Because of the variety of products, no one outline completely describes the process. In general terms, however, it would include casting, plating, rinsing, painting, machining, assembly, mixing and preparing chemical products.

## WASTE SOURCES

9. General:

Treatment of a metallic surface prior to the application of a metallic coating such as copper, nickel, chrome, gold, cadmium, zinc, etc., or prior to the application of paint or lacquer, usually involves the use of an alkali cleaner as one of the initial steps. Proprietary cleaners are usually used which may contain one or more of the following chemicals: sodium hydroxide, sodium carbonate, silicates of soda, sodium phosphate, and detergents.

Being strongly alkaline these materials are followed by water rinses and, in some cases, neutralizing acid dips before further treatment. Where removal of rust or heavy coatings of oxide is required, very strong acids are used. Water rinses follow these acid treatments. Water rinses of unknown quantities from both acid and alkaline cleaning processes are continuous discharges to the sewers. Such rinses are not shown on the following list of processing solutions used in the various departments. (See A below and B thru M on following pages.

Solutions, suspensions, or solids marked with an asterisk are normally only temporarily contained in vessels or are discharged directly into sewers. Alkali cleaners are used for one to four weeks before being discarded. Plating solutions, cyanide dips and acid dips generally have a much longer life before being discarded. Alkali cleaners and the latter group of solutions are periodically replenished in concentration of constituents since a certain amount of depletion takes place due to chemical or electro-lytic action, and to "drag-out" by parts in process. Heat treating baths are similarly replenished in concentrations over rather extended periods of time.

An average of about 50,000 gallons per day of combined process wastes are discharged to the Bay.

A. Metallurgical Department

1. Surface preparation and plating solutions
   - Alkali Cleaner
   - Nickel Strike
     - nickel chloride and hydrochloric acid
   - Copper Plating
     - copper sulfate and sulfuric acid
   - Nickel Plating
     - nickel sulfate, nickel chloride, boric acid, organic brighteners and wetting agents
   - Chromium Plating
     - chromic acid and traces of silicofluorides
   - Bright Dip
     - nitric and sulfuric acids
   - Gold Plating
     - gold cyanide, potassium cyanide, potassium carbonate

2. Processing Solutions
   - Sulfuric Acid - 5%*
   - Methyl alcohol*
   - Hydrochloric acid
   - Detergents*

B. Engineering Division:

Acetic acid*
Ammonia*
Sodium sulfite*
**Potassium Ferrocyanide***
Photographic developing and printing*

C. Chemical Department:

(residues washed from processing equipment)
Detergents*
Zinc oxide*
Arsenic tri-oxide*
Aluminum oxide*
Acetic acid*
Phosphoric acid*
Alginates*
Alcohols*
Toothpaste*

D. Chemical Laboratory:

Samples of all plating solutions, anodizing solutions and bonderizing solutions*. Solutions from general laboratory analyses containing mainly nitric, hydrochloric and sulfuric acids*.

E. Bur Department:

Copper Plating
    copper cyanide, sodium cyanide, sodium carbonate
Cyanide Dip
    sodium cyanide
Alkali Cleaners
    proprietary
Chromium Plating
    chromic acid, traces of silicofluorides
Copper Strip
    chromic acid, sulfuric acid, copper
Hydrochloric Acid
Steel Blackening
    Alkaline nitrate (proprietary)
Heat Treating Bath
    molten sodium cyanide

F. Chemical Packaging:

Glue, paste (from cleaning of equipment)*

### G. Handpiece Department:

- Heat Treating Baths
  - molten sodium cyanide, cyanate and carbonate
  - molten barium salt bath (neutral)
- Alkali Cleaner
  - proprietary

### H. Plating Room:

- Alkali Cleaners (10)
  - Proprietary cleaners containing hydroxides, silicates, borates and detergents
- Acid Dips

| | |
|---|---|
| hydrochloric (4) | (1-1 by volume) |
| sulfuric (5) | 5 to 35% |
| nitric (2) | 2% and 20% |
| nitric-sulfuric | (1-2 by volume) |

- Cyanide Dips (3)
  - sodium cyanide
- Dichromate Dip
  - proprietary - dichromate and nitric acid
- Copper Plating (2)
  - copper cyanide, sodium cyanate, sodium carbonate, Rochelle Salt, potassium cyanide, potassium carbonate, potassium tartrate, organic brighteners and wetting agents
- Nickel Plating (3)
  - nickel chloride, nickel sulfate, boric acid, organic brighteners and wetting agents.
- Chromium Plating
  - chromic acid, traces of silicofluorides
- Zinc Plating (2)
  - zinc cyanide, sodium cyanide, sodium hydroxide, sodium carbonate
- Cadmium Plating (3)
  - cadmium cyanide, sodium cyanide, sodium hydroxide, sodium carbonate.

### I. Japan Shop:

- Anodizing Process
  - alkali cleaner
- Bright Dip
  - chromic acid, sulfuric acid
- Anodizing Solution
  - sulfuric acid
- Dye Solution
  - organic dyes
- Acetate Sealer
  - nickel acetate
- Dichromate Sealer (2)
  - potassium dichromate (1-5%)
- Stripping Solution
  - chromic acid, phosphoric acid

J. **Bonderite Process:**

Alkali Cleaners (2)
Parcolene Z
    titanium phosphate
Bonderite Solution
    boric acid, ferrous sulfate, sodium fluoride, phosphoric acid, zinc and manganese phosphates
Parcolene (8)
    chromic acid

K. **Paint Strippers:** (3)

Alkali Solutions
Hydrochloric acid (conc.)

L. **Gas Department:**

Sulfuric Acid (1%)
Alkaline Potassium Permanganate
Salt Water*
Nitric Acid - ammonium nitrate solution* - 80 gallons per hour
    per generator (approximately 1.7 lb $HNO_3$ per 80 gallons)
Alkali Cleaners

M. **Power Plant:**

Regeneration of Hydrogen Zeolite water softener (weekly) - 83 lbs
    Sulfuric acid, discharged at about 2.5% solution
Sulfuric Acid
Sodium sulfite
Di-sodium phosphate
Sulfamic acid cleaners

## WASTE TREATMENT

All industrial wastes - 50,000 gpd - are discharged without treatment other than dilution. A survey made in 1964 by the New York City Health Department reported that the company treated its cyanide wastes with copperas. No mention was made of this type treatment during the December 1965 meeting.

## WATER POLLUTION ABATEMENT PROGRAM

An order to abate pollution was sent to the company by the New York City Health Department in 1962. Based on this order a consulting engineer was hired to develop an abatement program. The proposed solution included combining the industrial and domestic wastes discharges and treating them together in a septic tank system with a total capacity of 16,000 gallons. A 30 minute chlorination period at peak flow was also provided. The effluent from this system would be mixed with the cooling water return before discharge to Raritan Bay.

During the past year the Health Department has "loosened up" on their abatement order since a sewer is planned for the area. As the situation stands now S.S. White is waiting to connect to a city sewer and will not proceed with their original plans. As of this writing, no estimate is available as to when the city will provide the sewer.

# Procter and Gamble Manufacturing Company

## Port Ivory, Staten Island, N. Y.

### 1. Organization:

The Port Ivory plant of Procter & Gamble Manufacturing Co., is located at the northern end of the Arthur Kill in Port Ivory, Staten Island, N.Y. The facility, which employs approximately 1200 people, first began operation in this area in 1907. The plant presently occupies 122.5 acres.

### 2. Products:

The products of this plant are broken down into the following four categories:

Cake Mix - Duncan Hincs
Shortenings-Oils - Crisco, Fluffo, Primex, Flakewhite (latter two industrial)
Synthetic Detergents - Duz, Tide, Cheer, Oxydcl, Ivory Flakes
Soap-Bar: Lava, Camay, Ivory, Zest
  Liquid: Mr. Clean, Top Job
  Cleanser: Comet

### 3. Raw Materials:

Raw Materials used include:

Cake Mix - flour, sugar
Shortening - Oils - Soy bean oil, cotton seed oil, hydrogen
Synthetics - Linear alkyl benzenes, $H_2SO_4$, sodium phosphate
Soap - Animal fats, sodium and potassium hydroxide

Raw materials are delivered by both tank cars and trucks.

### 4. Capacity:

Figures on plant capacity or output are confidential; figures on raw product quantities are also unavailable. Reportedly, however, there is no seasonal fluctuation in output.

### 5. Operations:

Essentially there are four separate operations at this plant.

Cake Mix: flour, sugar and shortening are mixed to provide desired mix. Material is then packaged and shipped.

**Shortening--Oils**: Raw oils are refined, hardened by passing hydrogen through the oil, deoderized under vacuum, chilled and then packaged in cans or bottles.
**Soap**: Fats are split, yielding fatty acid; neutralization with caustic follows. Dry "plastic" product formed is extruded and cut into bar lengths, cured, stamped, and packaged.
**Synthetics**: neutralize LAS with $H_2SO_4$; add phosphate, builders and mix; spray dry, then package.

6. **Water Supply**:

Two sources of water are available, namely Arthur Kill and the municipal system of New York City. Fresh water, used at a rate of 1,800,000 gpd is used for steam generation, drinking and sanitary purposes, and for processing.

Salt water from the Arthur Kill is used on a once through basis for cooling at a rate of 4,000,000 gpd. Quality of Arthur Kill water presently satisfies the needs of the plant. No problems have been encountered with corrosion or clogging as a result of these waters being used for cooling.

7. **Sewerage**:

The Port Ivory Plant now has combined sewers discharging at a number of points -- eight -- into Bridge Creek, and one directly into the Arthur Kill where it joins Newark Bay. The total plant effluent includes wastes streams from:

1. Processing equipment used primarily in the manufacture of

    a. Household soaps and detergents
    b. Shortenings, edible oils and prepared baking mixes

2. Sanitary wastes from toilets and locker rooms

3. Plant cafeteria

4. Plant chemical laboratory

The average dry weather flow of wastewater from all sources, measured in June, 1963 during five consecutive operating days, was 5,450,000 gallons per day. The combined sewers also collect and discharge storm water run-off from much of the 122.5 acres of plant property.

## WATER POLLUTION ABATEMENT PROGRAM

### Background

Procter & Gamble realized many years ago that it would become necessary to stop discharging raw wastes to Bridge Creek and the Arthur Kill. A survey of Port Ivory wastes was completed in 1954 and updated in 1963 -- See Table I - in preparation for negotiations with the New York City Department of Public Works to accept these wastes for treatment in the Port Richmond Sewage Treatment Plant. Tests at the University of Wisconsin showed that P&G wastes could be treated satisfactorily in conjunction with domestic wastes.

The city agreed in principle with this joint treatment at a time when an interceptor sewer would be available to bring Port Ivory wastes to the Port Richmond treatment plant. Subsequent negotiations with the Department of Public Works confirmed the agreement in principle for joint treatment. P&G will pay treatment charges to the city in accordance with the established city schedule based on volume, suspended solids and biochemical oxygen demand.

Procter & Gamble received an order dated April 11, 1963 from the Commissioner of Health, City of New York, to cease discharging untreated wastes by April 26, 1964. The Commissioner of Public Works on May 23, 1963 wrote to the Commissioner of Health requesting an extension of the order to P&G on the basis that it would be in the best interest of the city to treat Port Ivory wastes at the Port Richmond Treatment Plant and that it would take both the city and P&G longer to complete the necessary engineering and construction. The date for compliance with the order now has been extended to June 1, 1967. There will probably be another extension of the order until mid-1968 which is the present New York City target date for completion of the Richmond Terrace interceptor.

## Summary of Plans

Procter & Gamble proposes to segregate dirty wastewater from clean wastewater with the installation of a new plant sewer system to collect all sanitary wastes and the industrial wastes which contain significant pollution. Detergent-bearing wastewaters will continue to be discharged to the Kill through a special sewer line.

### A. Clean Water

The existing sewer system will be reserved for storm water run-off and the discharge of clean cooling water, most of which is salt water. This system will continue to discharge through existing outfalls to Bridge Creek and the Kill. Table II shows the expected flows and characteristics of these flows.

### B. Detergent--Bearing Wastewater

Salt water used for scrubbing the exhaust air from the synthetic detergent spray drying tower and water used for periodic wash-down of the tower will be piped to the end of Pier No. 3 where the wastewater will be discharged into the Kill through a distributor submerged below low tide level.

### C. Dirty Water

A new sewer system will collect all sanitary wastes and those process wastewaters which are significantly polluted. Since certain limited outdoor areas in the plant, representing less than one percent of the total area, are subject to leaks and spills, storm water run-off from these areas also will join the sanitary sewers.

These polluted waters will be collected in a gravity sewer system ending in an underground sump. The wastes will be pumped out of the sump through a force main and discharged into a manhole of the city's projected interceptor sewer at the corner of Richmond Terrace and Western Avenue.

A detailed description of the new dirty water sewer system including pretreatment, anticipated flows and waste characteristics is given in the company supplied report. Pretreatment includes the use of fat traps, neutralization of acid wastes, and the use of flow limiting devices to reduce fluctuations in volume and BOD pumped to the city sewer.

### D. Pollution Abatement Effects

This sewer segregation project reportedly will have the following effects on the plant's discharge to Arthur Kill:

1. Remove all floating matter
2. Remove settleable solids
3. Remove color, taste and odor producing materials
4. Remove more than 85% of the present BOD contribution to Arthur Kill. Compared to 1954 loads the reduction reportedly may be as much as 96%.

The existing waste discharges contain no toxic materials or immediate dissolved oxygen demand.

### Status of Program:

P&G has already begun its program of reducing wastes loads -- eliminated Hydrolizer wastes in December 1965. Completion of the full pollution abatement program is expected to coincide with the date that New York City provides a sewer to the facility, mid-1968.

## TABLE I - 1963 SURVEY OF EXISTING WASTES

### Summary of Results of Sampling and Metering Program

| | | Average Pounds/day | | |
|---|---|---|---|---|
| Outfall | gpd-Flow | S.S. | B.O.D. | ABS |
| A | 596,000 | 1,100 | 3,335 | -- |
| B | Abandoned | -- | -- | -- |
| C | 14,200 | -- | -- | -- |
| D | 122,000 | 166 | 2,670 | -- |
| E | Abandoned | -- | -- | -- |
| F | 75,500 | -- | -- | -- |
| G | 2,770,000 | 1,400 | 1,215 | -- |
| H | 691,000 | 706 | 3,530 | -- |
| $I_1$ | 6,800 | 2 | 3 | 1 |
| $I_2$ | 200,000 | 592 | 269 | 239 |
| J | 962,000 | 665 | 943 | -- |
| Totals | 5,437,500 | 4,631 | 11,965 | 240 |

## TABLE II - PROPOSED DRY WEATHER FLOWS TO ARTHUR KILL
(see Appendix, Section 1 for additional detail)

| | | P&G Report | | |
|---|---|---|---|---|
| | | Average Pounds/Day | | |
| **Outfall** | **gpd Flow** | **S.S.** | **B.O.D.** | **ABS** |
| A | 131,000 | - | - | - |
| C | 14,000 | – | – | – |
| D | 65,600 | – | – | – |
| F | 75,400 | - | - | - |
| G | 2,460,000 | – | 491 | – |
| H | 278,000 | – | 3 | – |
| $I_1$ | 5,800 | – | – | – |
| $I_2$* | 201,000 | 592 | 269 | 240 |
| J | 1,065,000 | 22 | 15 | – |
| Totals | 4,295,800 | 614 | 778 | 240 |

**For Comparison**
Wastes to Arthur Kill from:

| | | | | |
|---|---|---|---|---|
| 1963 Survey | 5,437,500 | 4,631** | 11,965** | 240 |
| 1954 Survey | 5,610,000 | 14,500 | 18,500 | |

**Reduction From:**

| | | | |
|---|---|---|---|
| 1963 Survey | 21% | 87% | 93% |
| 1954 Survey | 23% | 96% | 96% |

* Detergent-bearing waters to be discharged at the end of Pier No. 3 instead of to Bridge Creek.

** Reductions in SS and BOD from 1954 to 1963 are the result of removing spent bleaching earths from the plant effluent and technological changes in processing.

# General American Transportation Corporation, Terminals Division

## Carteret, N. J.

### 1. Organization:

The Terminals Division of General American Transportation Corporation is located at the eastern edge of Carteret, New Jersey, adjacent to the Arthur Kill. The facility, located on 57 acres, employs approximately 200 people.

### 2. Products:

This facility of General American Transportation Corporation is a warehouse for a wide variety of liquid chemicals, naphthas, petroleum products and plastic pellets. The organization is essentially in the business of leasing storage tanks and providing manpower necessary for the shipment of these products. Approximately 20 to 25 chemical or petrochemical industries are participants in this operation.

Materials for this operation are brought in and distributed by ship, barge, truck or tank cars.

### 3. Capacity:

This plant has the capacity of storing approximately 2.5 million barrels of liquid.

### 4. Operation:

Essentially, this plant operates eight hours per day, five days per week. The waterfront operation, however, operates 24 hours a day, seven days per week.

### 5. Water Supply:

The only source of water is the Middlesex municipal supply. Approximately 100,000 gpd is used during the winter months -- 60,000 during other periods. Sixty percent of the water purchased is used for steam production; the remainder being used for cleanup, washdown and sanitary purposes.

Steam is used for heating approximately 20 percent of the tanks, normal heating, and for various smaller operations.

### 6. Sewage:

Sanitary wastes from the facility, with the exception of one building, are treated by septic tank systems. The area not being handled is discharged to the plant's oil-water separator system described below.

## WASTE TREATMENT

### 7. Oil-Water Separators:

This plant of General American Transportation Corporation, has two oil-water separators which receive run-off from the diked storage areas, plus any other cleanup or washdown waters. It is estimated that the flow to each unit is 4 gpm.

Reportedly, the sole source of wastes during dry periods is condensate from the steam system, and water lines which are kept running for reasons of safety. During the winter some of the plant's lines are kept running in order to eliminate freezing.

There are no analytical results available on the characteristics of the wastes which now discharge into the Arthur Kill.

## WATER POLLUTION ABATEMENT PROGRAM

At the request of the Interstate Sanitary Commission, the Terminals Division of General American Transportation Corporation, initiated studies to determine whether or not it would be economically feasible to treat their own wastes. Infilco, which is owned by General American Transportation Corporation, provided the technical assistance on this problem. The final decision reached was that it would be more economical, because of the low flows, to tie in with the municipal sewer system.

At the present time, the company has completed the design and has had plans approved for this tie in. It is anticipated that by no later than June 1, 1966, this connection will be completed. This arrangement is being made with the cooperation of FMC Corporation, who is permitting the Terminals Division to tie into their sanitary sewer, which in turn is connected to the municipal system.

## Archer Daniels Midland Company

## Elizabeth, New Jersey

### 1. Organization:

The Marine Oil Division plant of the Archer Daniels Midland Company is located at the eastern edge of Elizabeth, N. J., between the Arthur Kill and South Front Street. The facility, which employs approximately 50 people, began operation in this area about 80 years ago. The company's main executive and operating offices are located in Minneapolis, Minn.

### 2. Products:

This plant of the Archer Daniels Midland Company is essentially a fish and sperm oil processing plant. Production is by batch operations. The principal finished products are:

Fish Oil

Pressed
Refined -- used in paint and varnish industry

Sperm Oil

Pressed
Refined -- used as lubricating oil

Wax - used in cosmetic industry

Vegetable Oil - oxidized body used in paint and varnish industry

### 3. Raw Materials:

Raw materials used include:

Fish oils - 45% of crude

Sperm oils - 45% of crude

Vegetable oils - 10% of crude

Caustic soda, used for refining, 300,000 lbs per year

Sulfuric acid, used for neutralizing; 275,000 lbs per year

Sperm oils are delivered approximately five times per year by tankers, and fish oils are brought in approximately eight to 10 times per year by barges. Tank cars are used for supplying the crude vegetable oils. Crude is stored in tanks which have a total capacity of six million gallons.

4. Capacity:

The plant has the capacity of processing approximately 40,000 to 48,000 gallons per day of oil. There is no seasonal fluctuation in output.

5. Operations:

Essentially, there are three separate operations at this plant: Filtration of crude oils; oxidation of oils; and refining.

Filtration of Crude Oils: Crude fish and sperm oils are chilled and then filtered on a rotary-type vacuum filter.

Oxidation of Oils: A small quantity--1% to 2%--of the filtered fish oils, filtered sperm oils and vegetable oils are applied to the plant's blow tanks. The finished products from this process are blown oils and oxidized oils.

Refining Process: Filtered sperm oils and filtered fish oils, along with caustic, acid, steam and vacuum, are applied to the refining tank. The finished product from this unit is refined oils. The soap and wash water from the refining tank is further treated in a split tank to produce soap stock. Sweet water from the split tank is discharged to the separator. This waste will have a high BOD because of the glycerine content.

The refining process, presently a batch operation, is being converted to a continuous operation. This change over is expected to be completed by July 1, 1965.

The plant operates 24 hours a day, 7 days a week, 12 months a year. The availability of crude oil is the controlling factor in the plant's operation. All three crudes--fish, sperm, and vegetable oils--are generally run simultaneously.

6. Water Supply:

Two sources of water supply are available, namely, Arthur Kill and the municipal supply from the city of Elizabeth. Fresh water is used for steam generation, cooling oil processing kettles, refining, drinking and sanitary purposes. Water which is used for steam generation--maximum output 17,000 lbs/hr--is not condensed and re-used, as the company has found it desirable to let it go off as free steam rather than taking the chance of contaminating the condensate. Approximately 200,000 gallons per day of fresh water are used by this installation.

Salt water from the Arthur Kill is used at a rate of 240,000 gallons per day. This water is used on a once-through basis for the condensers in the plant's refrigeration system. The quality of the Arthur Kill water presently satisfies the needs of the plant. No problems have been encountered with corrosion or clogging as a result of these waters being used for cooling.

When comparing existing fresh water intake records with fresh water use--based on pump capacity and steam generating capacity--there is a large quantity of unaccounted-for water. Reportedly, a maximum of 22,200 gallons per day of fresh water is used in the filtration process; 3,000 gallons per day in the blow tanks; and 3,000 gallons per day in the refining tanks. The total capacity of the steam generating plant, as previously mentioned, is 17,000 lbs. per hour, which is equivalent to 35 gallons per minute (50,400 gallons per day). Therefore, the maximum total accountable-for fresh water is 77,600 gallons per day, which is far below the 165,000 gallon per day figure recorded by the company's water meter.

7. Sewerage:

All sanitary wastes from the facility go to the municipal plant--Elizabeth Joint Meeting. Processing waters and wastes are collected in open concrete lined trenches, which discharge to the separators.

8. Principal Processes:

Principal processes at the Archer Daniels Midland Company are filtration, oxidation and refining.

## WASTES TREATMENT

9. Oil-Water Separators:

This plant of the Archer Daniels Midland Company has two oil-water separators. The larger of the two units--10'6" X 19'11" X 6' SWD--is used continuously except for periods of cleaning when flow is diverted to the small--5' x 14' x 6' SWD--oil water separator. During the past year, the larger unit has only been taken out of service once.

Skimmings from the separators are pumped back to the plant for processing. Sludge is removed by scavanger approximately once a year.

There is presently no flow indicating or recording device at the plant. Flow records are based on water use data, which as previously mentioned, are questionable. It is estimated that wastes flows are approximately 15 gallons per minute with peaks reaching as high as 50 gallons per minute. Effluent from the treatment units is discharged to the Arthur Kill through 15 inch and 12 inch diameter submerged pipes.

10. Analytical Results:

Only parameter checked routinely--once a day--is pH of the effluent. Past records indicate that the change in temperature for the cooling water is approximately 8 - 10°F.

On July 19, 1962, a series of samples were taken by the N. J. State Health Department and the Interstate Sanitation Commission. Results of these grab samples are as follows:

| | Point I - Separator Effluent | | | Point II - Cooling Water Effluent | | |
|---|---|---|---|---|---|---|
| Sample No. | DO | BOD | Ether Soluble | DO | BOD | Ether Soluble |
| 1 | 0.8 | 82 | 289 | 5.5 | <11 | 18.1 |
| 2 | 6.9 | 127 | 349.7 | 5.7 | <10 | 11.8 |
| 3 | 1.6 | 117 | 64.4 | 5.6 | <7 | 20.1 |

COMPOSITE

| | Separator Effluent I | Cooling Water Effluent II | Raw Water Intake |
|---|---|---|---|
| DO | 0.8 | 5.9 | 0.4 |
| BOD | 104 | <15 | 64 |
| Alkalinity | 58 | 118 | -- |
| COD | 412 | 173 | 2,506 |
| Phenols | Trace | Trace | 0.05 |
| Sulfides | Neg | Neg | -- |
| Settleable Solids | 18.0 | 2.0 | 8.0 |
| Salinity | -- | 2.12% | 1.19% |
| Chlorides | 33.0 | -- | -- |

## WATER POLLUTION ABATEMENT PROGRAM

In 1963, the firm engaged Roy F. Weston, Inc., consulting engineers, for professional assistance and guidance with regards to water pollution control. The service provided involves quarterly review with the plant management of pollution control problems. Following such reviews, recommendations are made for maintaining and upgrading continuing control program. Recommendations from the consulting engineers have resulted in the following:

1. The broadening of the effluent sampling (pH) and observation program from once per week to once daily.

2. Design modifications of the oil water separator, which include changes in the inlet design and removal of all baffles but the final.

3. An inspection schedule to insure proper operation of the oil water separators--visits now made on an hourly basis.

4. Installation of an in-plant separator-holding tank to equalize water discharges and trap oily "heels" from batch treatment tanks. These units have reportedly prevented oil slugs and flow surges to the separator unit.

## Koppers Company, Inc., Forest Products Division, Port Reading Plant

## Port Reading, New Jersey

1. **Organization:**

The Port Reading Plant of the Forest Products Division of Koppers Company, Inc., is located at the eastern edge of Port Reading, New Jersey, adjacent to the Arthur Kill. This facility, located on 55 acres, 13 of which are in Carteret, was purchased by Koppers in 1956. The installation, built in 1910, was previously owned and operated by the Port Reading Railroad. At the present time, approximately 30 to 35 people are employed, with peaks of 50 being reached during the summer period.

2. **Products:**

This plant is essentially a wood preserving - creosoting - facility. Production is on a batch basis. The principal products are pilings, telephone poles and railroad ties.

3. **Raw Materials:**

Raw materials include wood - pine, oak or mixed hardwoods - in either pole or plank shape. Creosote and No. 6 fuel oil are used for preserving the wood.

Raw wood products may be either purchased by the company or supplied by a contractor, such as a railroad.

4. **Capacity:**

This plant has the capacity of processing or preserving 3,000,000 cubic feet per year of wood. Present output is approximately 1.5 million cubic feet per year.

5. **Operations:**

This plant can operate 24 hours a day, seven days a week, 12 months per year; at the present time, however, it is operating on a two shift, five day per week basis.

Wood, prior to impregnating, is dried either in the atmosphere or in a steam atmosphere in the plant's treating cylinder. After this pretreatment the wood is handled in the following manner:

1. Tram cars loaded with dried wood are placed inside the treating cylinder - 88 inches in diameter by 144 feet long.

2. Cylinder is sealed at both ends and filled with air in order to occupy the voids in the wood.

3. Cylinder is then filled with either creosote or a mixture of creosote and oil, at a temperature of 200°F. and at a pressure of 185 psi. Detention under these conditions, depending on the type wood and product desired, varies from 2 - 2½ hours.

4. Impregnating solution is removed from treating cylinder.

5. A vacuum is pulled on the whole cylinder in order to remove excess oil from the voids.

6. Wood is then removed and stored, ready for shipment.

Under normal conditions, 12 pounds of oil are applied per cubic foot of wood. If extra protection is needed, such as for salt water pilings, the wood contains upwards of 25 pounds of oil per cubic foot. Under these conditions the wood in the treating cylinder is initially placed under vacuum so as to permit greater absorption of the oil into the voids. (Step 2.)

6. Water Supply:

Only one source of water is available at this plant, namely, the Middlesex Water Company. Fresh water is used at a rate of approximately 1,000 gpd, with peaks running as high as 1,500 gpd. This water is used for makeup water in the recirculating cooling water system; cooling the air compressor; for vacuum units in the treating cylinder; and for sanitary and drinking purposes.

Steam, used in heating and processing, is purchased from the Sinclair Koppers Plant on the adjacent property.

Since the major source of wastewater is that volume of water which is trapped in the voids of wood - under normal conditions, 85 to 90 percent of the wood by weight is water - no comparison can be made between fresh water consumption and waste discharge volumes.

7. Sewage:

It is presumed that all sanitary wastes from this facility discharge to a septic tank. No plans or drawings are available to document this fact.

## WASTE TREATMENT

8. Oil Water Separators:

Sources of wastewater are as follows: Steam condensate; water removed from the wood in the treating cylinder; floor washings; and water accumulations from pump drains. The average total flow is 5,000 to 7,000 gpd.

The plant's separator-type system consists of the following: Blowdown tank - most of settling takes place in this unit; dehydrator; two interconnected, heated, cylindrical settling units; and two rectangular-shaped settling tanks equipped with baffles to trap oil. (See diagram-FWPCA Files)

Oil recovered from the bottom of the blowdown tank goes to the oil dehydrator where steam is injected to boil off the water. The reclaimed oil is either sold or used within the plant. Decant from this tank then passes through the other settling-separating units before being discharged to a small tributary creek to the Arthur Kill.

9. Analytical Results:

The plant, because of its size, does not maintain continuous surveillance of its effluent. The task of checking the discharge is the responsibility of the company's research center at Monroeville, Pa. Results of a study conducted by this group on July 24, 1962, are as follows:

| | |
|---|---|
| COD | 6,300 ppm |
| BOD | 2,500 ppm |
| Phenol | 130 ppm |
| pH | 5.8 |
| Chloride | 145 ppm |
| Turbidity | 2,200 JCU |
| Total solids | 2,280 ppm |
| Fixed solids | 360 ppm |
| Suspended solids | 880 ppm |
| Settleable solids | 0.2 ml per liter |

Samples were collected on a composite basis over an eight hour period and analyzed at the Monroeville Research Center.

The following are average wastes characteristics as supplied by the company:

| | |
|---|---|
| Flow | 3,000 to 5,000 gpd |
| $BOD_5$ | 1,500 to 3,500 ppm |
| pH | 5.5 to 6.5 |
| Chlorides | 100 to 200 ppm |
| Total solids | 2,000 to 3,000 ppm |
| Fixed solids | 300 to 1,000 ppm |
| Phenol | 100 to 150 ppm |
| COD | 4,000 to 6,300 ppm |
| Oil (ether extraction) | 500 to 1,000 ppm |

The average figures supplied by the company are based on previous samplings at this plant and on effluent data from other company owned plants of the same capacity.

10. Pollution:

Wastes presently being discharged by Koppers are highly polluted. During the visitation, it was noticed that sludge from the creosote storage tanks was disposed of in an undiked area adjacent to a stream tributary to the Arthur Kill. During a storm period, it is felt that leaching from these sludge deposits could produce a noticeable phenolic load on the Arthur Kill.

## Johns-Manville Products Corporation,

## Manville, New Jersey

### 1. Organization:

The Johns-Manville complex is divided into two sections: Research and Engineering Center at Finderne, N. J., and the Manville Plant, which is the production facility, at Manville, N. J. The Research Center, built in 1946, is located on 96 acres and employs approximately 850 people. The Manville Plant, located approximately two miles above the confluence of the Millstone and Raritan Rivers, was built in 1912 and presently employs 3,150 people. The actual plant site occupies 185 acres; however J-M owns an additional 210 acres west of the plant.

### 2. Products:

#### Research and Engineering Center

Pilot production only, on new products and processes, is carried out at this location.

#### Manville Plant -- Water-formed production

Roofing felt (organic)
Asbestos paper
Flex-board (asbestos cement product)
Transite pipe
Cerro-form (ceramic fibers in wet medium)

#### Manville Plant -- Dry-formed

Asbestos Textiles
Asbestos packings (sheet, coil)
Friction materials (brake linings, clutch facings)
Floor tile
Insulation (high temperature)
Lime-silica insulation (steam lines and boilers)
Asphalt roofings (rolls and shingles)
Asbestos cement shingles

### 3. Raw Materials:

#### Research and Engineering Center

None, other than those needed for pilot operations.

### Manville Plant -- Wet-formed production

Raw materials used include:

Asbestos fiber
Portland cement
Celite
Silica
Hydrated lime
Wood (Jersey Pine)
Waste paper
Starch
Acryllic emulsion
Polyvinyl chloride emulsion
Silicate of soda
Separan*
Nalco-21S*
No. 2 fuel oil*

*Used to treat process water.

4. Capacity:

Water-formed production during 1964 amounted to 170,700 tons. This type production accounts for approximately 50-60 percent of total plant production.

5. Operations:

### Research and Engineering Center

This facility functions on an 8 hour day, 5 day week. Operation consists primarily of pilot studies on new products and processes.

### Manville Plant

Operation of this complex is on a 24 hour per day, 5-7 day per week, 52 week per year basis.

6. Processes:

### Research and Engineering Center

None, other than various experimental processes.

### Manville Plant

Only the two major water-formed products are described:

Transite Pipe - Mixing of cement, asbestos and silica to form a mat which is rolled on a mandrel until the desired thickness of pipe is attained. Mandrel is removed; pipe then cured in steam atmosphere for 20 hours - equivalent to 28 days; hydrostatic test performed on each pipe prior to shipment.

Roofing Felt (Organic) - half of raw material from mixed papers processed in hydrapulper; other half comes from chipped Jersey pine processed through defibrators operating at 180 psi steam pressure. After blending and refining, the combined pulp is diluted to vat consistency of about 1%; screened and then formed on a single 120-inch face cylinder mold. Resulting web passes through wet pressing equipment to rotating steam drier rolls and intermediate and final calendering units which produce porous finished product.

Two paper machines, Number 5--with a capacity of 100 tons/day--and Number 4-- with a capacity of 50 ton/day--are used for felt production. Bleed off from these machines - white water - averages approximately 20 gpm. It is estimated that the BOD of this waste equals 2,000 mg/l.

7. Water Supply:

Three sources of water, namely, Raritan River, Borough of Manville, and wells located on company property, are utilized.

Raritan River - Water used essentially for cooling and wet processing: Present total use - 13 mgd; maximum withdrawal 18.0 mgd.

Water used for power house cooling--approximately 7.0 mgd of the 13.0 total - is discharged back to the Raritan with a temperature elevation of about 20°F. Manville plant uses approximately 4.0 mgd for processing. An additional 0.5 mgd, obtained from the filtration plant which services the Research Center, is used as boiler feed.

The Research and Engineering Center withdraws approximately 1.0 mgd for processing and for washroom use at the Center. As mentioned above, half of this total goes to the Manville plant. Treatment of this water consists of rapid sand filtration and chlorination.

Borough of Manville - Approximately 0.33 mgd for drinking purposes and special manufacturing operations.

Well water - Approximate use - 40,000 gpd. Well capacity is 0.3 mgd. Water used for high pressure jet cleaning.

A detailed water balance is given in Table I at the end of this report.

8. Sewerage:

Each section of the J-M complex - Manville Plant, Research and Engineering - maintains and operates its own wastewater treatment plant. Domestic wastes, however, are handled separately at the Borough of Manville Sewage treatment plant.

## POLLUTION ABATEMENT PROGRAM

9. Wastes Treatment:

### Research and Engineering Center

Primary plant, designed for maximum flow of 1.4 mgd. Sludge dewatered on vacuum filters. Chlorinated effluent discharged to Raritan River approximately 100 feet downstream from water intake for Research Center.

During the period January 1, 1965 to October 31, 1965 flow averaged 0.515 mgd; BOD influent - 24.6 mg/l, effluent - 14.4 mg/l; SS influent - 246 mg/l, effluent - 22 mg/l. Spot checks indicated coliform organisms were absent in effluent.

### Manville Plant

Treatment consists of clarification, neutralization and chlorination. Facilities are designed for a maximum flow of 6 mgd. Detention time in sedimentation units--two earthen diked basins used on an alternating basis--averages 7 hours. Effluent is combined with Borough of Manville's, prior to being discharged below the confluence of the Millstone and Raritan Rivers.

During the period January 1, 1965 -- October 31, 1965, flow averaged 4.6 mgd; BOD influent -- 33.4 mg/l, effluent - 20.6 mg/l; SS influent- 469 mg/l, effluent - 17.2 mg/l; pH reduction 10.9 to 8.0; coliform organisms - none.

## TABLE I

## RARITAN RIVER USE - 1964

## JOHNS-MANVILLE PRODUCTS CORP.

## MANVILLE PLANT AND RESEARCH & ENGINEERING CENTER

| | Manville Plant | | Research & Engineering Center | | Total | |
|---|---|---|---|---|---|---|
| A. Average Use-MGD | Intake col. 1 | Discharge col. 2 | Intake col. 3 | Discharge col. 4 | Intake col. 5 | Discharge col. 6 |
| 1. Process | | | | | | |
| a. Raritan | 3.95 | 3.95 | 1.0 | .5 | 4.95 | 4.45 |
| b. Raritan | - | .5* | - | - | - | .5 |
| c. Non-Raritan | .35 | .35** | - | - | .35 | .35 |
| d. Metered **** | - | (4.8) | (1.0) | (.5) | - | (5.3) |
| 2. Power Generation | | | | | | |
| Raritan | 7.0 | 7.0 | - | - | 7.0 | 7.0 |
| 3. Sanitary Sewage to Boro of Manville Sewers - Raritan | .2 | - | .1 | - | .3 | - |
| Total Raritan | 11.15 | 11.45 | 1.1 | .5 | 12.25 | 11.95 |
| Total Non-Raritan | .35 | .35 | - | - | .35 | .35 |
| Grand Total | 11.5 | 11.8 | 1.1 | .5 | 12.6 | 12.3 |
| B. Peak Use - MGD | | | | | | |
| 1. Process-Raritan Only | 4.9 | 5.5 | 1.2 | .6 | 6.1 | 6.1 |
| 2. Power Generation | 7.0 | 7.0 | - | - | 7.0 | 7.0 |
| 3. Sanitary Sewage | .2 | - | .1 | - | .3 | - |
| 4. Fire Protection | 4.3 | 4.3 | 1.4 | - | 4.3 | 4.3*** |
| | 16.4 | 16.8 | 1.3*** | .6 | 17.7 | 17.4 |

*Transfer from Research & Engineering Center

**Non-Raritan Water .3MGD from Boro of Manville and .05 MGD from Plant We

***Total includes Manville plant fire pumps only - (assumed that fires would rarely occur simultaneously at both locations)

****Not included in totals - explanatory only

# Philip Carey Manufacturing Company

## Perth Amboy, New Jersey

### 1. Organization:

The Philip Carey Manufacturing Company is a publicly owned company occupying 43 acres in Perth Amboy, New Jersey. Main offices are in Lockland, Cincinnati 15, Ohio.

Approximately 250 people - 60 percent day shift, 25 percent second shift, 15 percent night shift - are employed on a round-the-clock basis. During the summer months the plant operates 6 or 7 days per week. A 5-day week is observed during other periods of the year.

### 2. Products:

Asphalt and asbestos building and roofing materials.

### 3. Raw Materials:

| | |
|---|---|
| Waste paper | 17,000 tons/year |
| Cord wood | 11,000 tons/year |
| Jute | 600 tons/year |
| Sawdust | 900 tons/year |
| Asphalt | 47,000 tons/year |
| Tar | 5,000 tons/year |
| Roofing granules | 26,000 tons/year |
| Sand | 8,000 tons/year |
| Limestone | 21,000 tons/year |
| Asbestos | 1,800 tons/year |
| Portland cement | 6,000 tons/year |

### 4. Capacity:

To be supplied by company.

### 5. Operation and Processes:

The plant is divided into two sections -- asphalt and asbestos. In the asphalt section a mechanical pulp is made, pressed and dried. Asphalt and roofing granules are then applied to the rolled sheets.

In the asbestos section a mechanical asbestos pulp is produced. The remainder of the process is the same as in the asphalt section.

6. Water Supply:

Approximately 600,000 gpd of water are purchased from Perth Amboy's municipal supply.

7. Sewerage:

Three sewers carry all sanitary wastes to the City of Perth Amboy.

8. Waste Sources:

Asphalt pulp section - 72 mg per year of process waste
- 33.3 mg per year of boiler water

Asphalt application section - 57.2 mg per year of process waste

Asbestos section - 48.6 mg per year of process waste

## POLLUTION ABATEMENT PROGRAM

9. Wastes Treatment:

The operation sections of the plant are served by a Dorr-Clarifier treatment unit. A variable pH as well as high concentrations of solids and ether soluble material led to the installation of these treatment facilities. Present plans call for bringing wastes from the asbestos section to the treatment unit so as to obtain neutralization of the wastes.

10. Analytical Results:

Results of analyses, made before the clarifiers were installed, are as follows:

| | |
|---|---|
| 5 day BOD | 18-42 ppm |
| 10 day BOD | 32 ppm |
| ether soluble | trace to 11.4 ppm |
| total solids | 178-287 ppm |
| suspended solids | 39-144 ppm |
| dissolved solids | 139-143 ppm |
| pH of asphalt section | 6.5 |
| pH of asbestos section | 10.0 |

Effluent from both units is presently discharged to the Raritan River and sludge is disposed of at a land fill site.